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Energy Research Abstracts

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February 15, 1988

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ENERGY RESEARCH ABSTRACTS

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88-00135

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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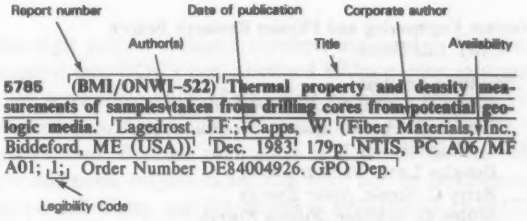
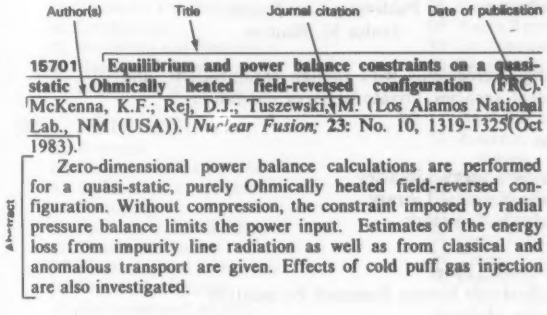
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* 23: No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
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• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI–522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI–522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Biomass Conversion Service
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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

0103 Preparation

REFER ALSO TO CITATION(S) 5376, 5386, 5387

5366 **(DOE/PC/80530—T4) Carbon dioxide for fine coal flotation: Progress report, first quarter, second year.** Miller, J.D. (Utah Univ., Salt Lake City (USA). Dept. of Metallurgy and Metallurgical Engineering). Oct 1987. Contract FG22-85PC80530. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002646/JAW.

Preliminary FTIR experimental work described in the first Annual Report has demonstrated the potential for the characterization of coal hydrophobicity by FTIR spectroscopy. In this regard, detailed research has been carried out on hydrophobicity characterization of fine coal using FTIR spectroscopy. FTIR spectra were recorded by a DIGILAB FTS-40 FTIR spectrometer using a diffuse reflectance technique. The diffuse reflectance accessory, COLLECTOR, was obtained from Spectra-Tech Inc. A germanium-coated KBr beam-splitter and a liquid nitrogen-cooled Hg-Cd-Te detector were used, and each spectrum of coal was obtained for 700 scans at 2 cm^{-1} resolution with KBr powder a background. Since sharp absorption bands for net coal samples were achieved, the samples were not diluted with KBr. Because diffuse reflectance FTIR spectroscopy can reveal the microscopic or molecular nature of the coal surface, attempts have been made to describe coal hydrophobicity by this new technique.

5367 **(DOE/PC/80530—T6) Carbon dioxide for fine coal flotation: Progress report, second quarter, second year.** Miller, J.D. (Utah Univ., Salt Lake City (USA). Dept. of Metallurgy and Metallurgical Engineering). Oct 1987. Contract FG22-85PC80530. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002647/JAW.

X-ray photoelectron spectroscopy (XPS) is generally considered an important and key technique for surface characterization. This technique provides a total elemental analysis of any solid surface which is vacuum stable or can be made vacuum stable by cooling. XPS is generally regarded as being the most quantitative, the most readily interpretable, and the most informative technique with regard to chemical composition. Previous researchers have used XPS to characterize the surface of coal and associated components. The major elements such as C and O as well as the trace elements in the surface layer have been successfully determined using XPS. However, so far XPS experimental results have not been related to the hydrophobic character of the coal surface. During this quarter, research efforts have been made to characterize the XPS characteristics of the coal surface in terms of its hydrophobic character.

5368 **(PB—87-227476/XAB) Physical coal-cleaning/ flue-gas desulfurization computer model. Model simulation.** Wright, C.R.; Sudhoff, F.A.; Jones, J.W. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Aug 1986. mag tap. NTIS CP T19.

Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—87-227484.

The model consists of four programs: (1) one, initially developed by Battell-Columbus Laboratories, obtained from Versar, Inc.; (2) one developed by TVA; and (3,4) two developed by TVA and Bechtel National, Inc. The model produces design-performance criteria and estimates of capital investments and annual-revenue requirements for a physical coal-cleaning and a limestone or lime FGD system, either separately or as a combined emission-control system. The primary use of the model is expected to be for projecting comparative economics of coal-cleaning and limestone- or lime-FGD systems in combination or as separate systems...Software Description: The model is written in the FORTRAN programming language for implementation on a IBM 3084 Computer using the MVS SP2.1.2 Rel 3.8 operating system.

5369 **(PB—87-227484/XAB) Coal-cleaning and flue-gas desulfurization computer model. User's manual. Report for October 1979-June 1983.** Wright, C.R.; Sudhoff, F.A. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Nov 1986. 270p. (TVA/OP/EDT—83/17). NTIS, PC A12/MF A01.

For system on magnetic tape, see PB—87-227476.

This manual describes a combined coal-cleaning and flue-gas desulfurization (FGD) computerized design and cost-estimate model and gives detailed procedures for using it. All inputs and outputs are described, as well as the various options available. Design and economic premises are included. The model consists of four programs: (1) one, initially developed by Battell-Columbus Laboratories, obtained from Versar, Inc.; (2) one developed by TVA; and (3,4) two developed by TVA and Bechtel National, Inc. The model produces design-performance criteria and estimates of capital investments and annual revenue requirements for a physical coal-cleaning and a limestone- or lime-FGD system, either separately or as a combined emission-control system.

0104 Processing

REFER ALSO TO CITATION(S) 5385, 5567, 5569, 5690

5370 **(CONF-8605306—1) Utilization of hydrogen during coal liquefaction.** Bockrath, B.C.; Finseth, D.H.; Illig, E.G. (USDOE Pittsburgh Energy Technology Center, PA). 1986. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013703/JAW.

From EPRI conference; San Francisco, CA, USA (6 May 1986).

The patterns of hydrogen utilization are determined for a number of different coal conversion conditions. The total uptake of hydrogen is divided into the four categories of gas make, heteroatom removal, change in aromaticity, and cleavage or formation of matrix bonds. Liquefaction temperature strongly influences the extent of hydrogenation of aromatic carbon. Even under significant hydrogen pressure, hydroaromatic compounds underwent net dehydrogenation at temperatures above 400°C. A system comprising water, carbon monoxide, and a basic catalyst was able to hydrogenate coal at 350°C to a greater degrees than hydrogen under the same conditions with or without ammonium molybdate added as catalyst. Kinetic experiments with conventional liquefaction feed slurries indicate that tetrahydrofuran and cyclohexane conversions increase with time under low-severity conditions. There is a parallel increase in hydrogen incorporated to break matrix bonds, but the amount incorporated to liberate heteroatoms does not correlate strongly with conversion. 6 refs., 2 figs.

5371 **(DOE/FE—0092) Comprehensive report to Congress Clean Coal Technology Program: Prototype commercial coal/oil co-processing plant: A project proposed by Ohio Ontario Clean Fuels, Inc.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Oct 1987. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002370/ JAW.

The Ohio Ontario Clean Fuels, Inc., project will demonstrate a technology that produces clean liquid fuels from high-sulfur, high-nitrogen, Ohio bituminous coal, and poor-quality petroleum residuum. This project is intended to demonstrate the technical, environmental, and economic advantages of co-processing coal and residuum oil versus the utilization of these resources separately. The prototype commercial plant for this demonstration will produce approximately 7250 barrels per day (BPD) of middle distillate and 4,500 BPD of naphtha for a total liquid fuel production of 11,750 BPD. Other fuel products include approximately 340 BPD of propane, 190 BPD of butane, and 185 tons per day (TPD) of flaked bottoms. Other products also include 57 TPD of sulfur and 14 TPD of ammonia. The main feed materials for this facility will be 800 TPD of high-sulfur Ohio No. 5/6 coal and 8675 BPD of Cold Lake heavy crude oil. The demonstration will be conducted at the partially utilized site of a currently active steel distribution facility. This site is serviced by oil and gas pipelines and other important utilities. Milestone schedule is presented for the project which extends for eighty-six months.

5372 **(DOE/FE—0093) Comprehensive report to Congress Clean Coal Technology Program: UCG/clean fuels proof-of-concept project: A project proposed by Energy International, Inc.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Nov 1987. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002571/JAW.

One of the selected projects of the Clean Coal Technology (CCT) Program was an underground coal gasification (UCG) demonstration project proposed by Energy International, Inc. (EI). The in situ, or underground, gasification of coal promises several advantages over the conventional process of mining the coal and transporting it to a surface gasification facility: (1) the ability to recover coal resources which are nonrecoverable using current mining technology, (2) the elimination of the high capital costs associated with a conventional mining and surface gasification facility, and (3) the ability to bring a plant on stream faster because a long construction period is not required. If the demonstration project is successful, EI plans to continue operations at the demonstration site, resulting in immediate commercial utilization of the demonstrated technology. The work to be performed under the Cooperative Agreement covers the design, construction, and operation of the demonstration plant. This project is estimated to cost $70,115,454 with the government share being $11,792,362. The Participant has agreed to absorb any cost overruns and has agreed to a plan to repay the government's contribution. The cooperative agreement period is approximately 36 months long, with a 12-month operating and performance monitoring period. Construction is scheduled to commence by the spring of 1988, with the operational phase of the project starting in the fall of 1989. 7 figs., 2 tabs.

5373 **(DOE/MC/23057—2503) Novel concept development of an internal recirculation catalyst for mild gasification: Progress report, March 1-May 31, 1987.** Solka, B.H.; Anderson, G.L.; Feldkirchner, H.L.; Babu, S.P. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1987. Contract AC21-86MC23057. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002445/JAW.

This report presents the results of work on DOE Contract AC21-86MC23057, "Novel Concept Development of Internal Recirculation Catalysts for Mild Gasification." The objective of the program is to provide an overall evaluation of a novel process concept for mild coal gasification by completing work in three major tasks: (1) Laboratory-Scale Experiments, (2) Bench-Scale Tests, and (3) Proof-of-Concept Tests and Evaluation (optional). All work in this quarter was performed on Task 1, Laboratory-Scale Experiments. Results from 63 experiments included devolatilization of Illinois No. 6 coal in helium and a helium-hydrogen mixture and Wyodak coal in helium. Experiments included on-line product analysis by gas chromatography-mass spectrometry (GC/MS). Product analysis by GC extended the upper boiling point limit of detectable products to compounds 15 carbon atoms larger than could be analyzed with the GC/MS method and substantially increased the recovery of the condensable product fraction. The presence of CsOH caused several changes in the nature of the chemical composition of the condensable devolatilization products. These included increases in the degree of aliphatic character of the product at more severe thermal conditions, an increase in the phenolic content at all thermal conditions and decreases in organosulfur compounds with accompanying increases in hydrogen sulfide. CsOH also caused large increases in the yield of carbon dioxide and slight increases in the sums of char and a heavy tar which was of insufficient volatility to leave the reaction zone. Experiments with pure n-$C_{44}H_{90}$ indicated that this non-volatile tar must have had a mean boiling point substantially above 1000°F.

5374 **(DOE/MC/23075—2351) Measurement and modeling of advanced coal conversion: Quarterly report, January-March 1987.** Solomon, P.R.; Hamblen, D.G.; Serio, M.A.; Smoot, L.D.; Brewster, S. (Advanced Fuel Research, Inc., East Hartford, CT (USA); Brigham Young Univ., Provo, UT (USA)). Mar 1987. Contract AC21-86MC23075. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE87006488/JAW.

The overall objective of this program is the development of computer-aided reactor engineering technology for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. Current computer-aided reactor engineering technology has shown significant potential, but there is a need to bring the technology to a higher level of generality, accuracy and acceptability. This program will merge significant advances made at Advanced Fuel Research, Inc. (AFR) in predicting coal conversion behavior, with technology being developed at Brigham Young University (BYU) in comprehensive computer codes for mechanistic modeling of entrained-bed gasification. The foundation to describe coal-specific conversion behavior will be AFR's Functional Group (FG) and Devolatilization, Vaporization, and Crosslinking (DVC) models, developed under previous and on-going METC sponsored programs. These models have demonstrated the capability to describe the time dependent evolution of individual gas species, and the amount and characteristics of tar and char. The FG/DVC models will be integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2, which is currently the most widely used reactor simulation for combustion or gasification. The program includes: (1) validation of the submodels by comparison with laboratory data obtained in this program, (2) extensive validation of the modified comprehensive code by comparison of predicted results with data from bench-scale and process scale investigations of gasification, mild gasification and combustion of coal or coal-derived products in heat engines.

5375 **(DOE/MC/23289—2379) Development of mild gasification process: Quarterly report for the period January-March 1987.** Chu, C.I.C.; Gillespie, B.L. (UCC Research Corp., Bristol, VA (USA)). May 1987. Contract AC21-87MC23289. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87006504/JAW.

The test plan for optimizing the mild gasification process was submitted and finalized during this report period. The optimization process will be accomplished in two phases. Phase I includes determination of the optimum reactor tube diameter, effects of bed height, and the effect of coal weathering on the mild gasification process. Phase II of the optimization process is modification of the MGU followed by parametric testing in the modified MGU. Applied Science and Technology was chosen to be the engineering subcontractor to UCCRC for MGU modifications. Four major areas have been identified as needing modification: the coal feed system, the condensing system, reactor tube diameter, and the reactor tube support system. In preparation for installing the new reactors for reactor diameter optimization tests, the existing char chute, hydraulic plungers, coal feed assembly, and the 8-inch cast reactor tubes have been removed from the MGU.

5376 **(DOE/PC/50261—T5) Investigate the effectiveness of calcium treated coals in the capture of sulfur gases generated in staged fired combustors: Final report, September 27, 1982 through July 26, 1984.** Porter, J.H.; Manning, M.P.; Benedek, K.R.; Sharma, P.K.; Sachs, K.M. (Energy and Environmental Engineering, Inc., East Cambridge, MA (USA)). 1987. Contract AC22-82PC50261. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87013917/JAW.

A number of processes for desulfurizing flue gases from coal fired utility boilers and furnaces have been tried with varying degrees of success. A potentially attractive process for use in retrofitted units for firing pulverized coal in water suspension is the pretreatment of the coal with calcium additives before firing. Since the calcium will remain in the ash during combustion, calcium sulfates which may form by reaction of SO_2 with calcium can be removed from the flue gas with the ash. The process is much simpler than those in which the contact between the flue gas and limestone is carried out in a separate down-stream unit and may have much higher sulfur capture efficiencies than when injecting limestone and coal as separate phases. The success of the process hinges on the degree to which the sulfur is captured by calcium fixed in-situ in the coal matrix under the conditions prevailing in the combustion chamber and the cost of the calcium fixation process. 39 refs., 18 figs., 6 tabs.

5377 **(DOE/PC/80507—T8) Catalytic coal gasification: Identification of active sites, July 15, 1987-October 14, 1987.** Falconer, J.L.; Lauderback, L.L. (Colorado Univ., Boulder (USA)). 22 Oct 1987. Contract FG22-85PC80507. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001341/JAW.

This research uses transient isotope tracing, at steady-state reaction conditions, in combination with surface analysis techniques (secondary ion mass spectrometry (SIMS) and x-ray photoelectron spectroscopy (XPS)). Carbon dioxide gasification of carbon blacks and coal char will be used initially. In a typical isotope tracing experiment, $^{13}CO_2$ flow over a carbon-catalyst mixture will be quickly replaced by $^{12}CO_2$ at the same pressure and flow rate. The changes in the concentrations of ^{12}CO and ^{13}CO products, and in the $^{12}CO_2$ and $^{13}CO_2$ concentrations, as a function of time, will be measured with a computer-controlled mass spectrometer. The use of isotope transients allows the concentration of active catalytic sites to be measured directly at reaction conditions and it allows the rate constant to be measured. Surface analysis techniques will be used to determine the active forms of the catalysts. Model studies of catalyst-carbon interactions will also be carried out with SIMS in order to determine the form of surface species. The combination of isotope tracing and surface analysis will elucidate the details of the reaction mechanism.

5378 **(EUR—11016) Technical research, development and demonstration in the solid fuels sector.** Kindermann, F.W.; Wilkinson, J.K.; Furfari, S. (Commission of the European Communities, Brussels (Belgium). Directorate General for Energy). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900225/JAW.

The ESCS coal research program has fostered the development of very advanced mining technology with a high level of safety, the opening-up of new markets and the utilization of coal with improved protection of the environment. R and D activity must nevertheless be continued in order to maintain and improve the standards achieved. In the same way, the subprogram on solid fuels in the EEC non-nuclear energy R and D program will certainly also contribute towards improved utilization of such fuels with respect to techniques, efficiency, economy and protection of the environment in the field of combustion. The pilot and demonstration projects on liquefaction and gasification of solid fuels will create a medium to long-term option for the diversification of the Community's energy sources which, in spite of current circumstances, will in all probability become necessary again. In the shorter term, the demonstration projects on the substitution of hydrocarbons by solid fuels should make possible a more rapid transfer of the results of previous R and D activities to practical, industrial use, especially with regard to the use of solid fuels in medium and large combustion installations. The four activities described add up to make a comprehensive and balanced overall European Community program, embracing all aspects of research, development and demonstration in the field of solid fuels, ranging from basic research in the laboratory to the final stage before commercialization. 5 tabs.

5379 **(ORNL/FMP—87/4) Fossil Energy Materials Program conference proceedings.** Judkins, R.R. (comp.). (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 782p. (CONF-8705103—). NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88002250/JAW.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

The US Department of Energy Office of Fossil Energy has recognized the need for materials research and development to assure the adequacy of materials of construction for advanced fossil energy systems. The principal responsibility for identifying needed materials research and for establishing a program to address these needs resides within the Office of Technical Coordination. That office has established the Advanced Research and Technology Development (AR and TD) Fossil Energy Materials Program to fulfill that responsibility. In addition to the AR and TD Materials Program, which is designed to address in a generic way the materials needs of fossil energy systems, specific materials support activities are also sponsored by the various line organizations such as the Office of Coal Gasification. A conference was held at Oak Ridge, Tennessee on May 19-21, 1987, to present and discuss the results of program activities during the past year. The conference program was organized in accordance with the research thrust areas we have established. These research thrust areas include structural ceramics (particularly fiber-reinforced ceramic composites), corrosion and erosion, and alloy development and mechanical properties. Eighty-six people attended the conference. Papers have been entered individually into EDB and ERA. (LTN)

5380 **(PB—87-227179/XAB) Automatic coking control system for coke ovens.** Nakagawa, Y.; Naganuma, Y.; Tanaka, K.; Matsuo, T. (Nippon Steel Corp., Tokyo). 1987. 7p. (In Japanese). NTIS, PC E05/MF A01.

Included in Seitetsu Kenkyu, No. 325, 53-60(1987).

An automatic coking control system was developed to achieve substantial energy and manpower saving through the stabilization and optimization of coke oven operations. The system has been installed at all 21 batteries in operation at NSC. The paper describes the concept and structure of the coal-coking control system and reports the excellent operation results achieved by this system.

5381 **(PNL-SA—15010) Separation of gas mixtures by supported complexes.** Lilga, M.A. (Pacific Northwest Lab., Richland, WA (USA)). 29 May 1987. Contract AC06-76RL01830. 6p. (CONF-870659—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000990/JAW.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The current project centers on the preparation and characterization of complexes that can be used to separate H_2 from gas mixtures. Of interest are complexes which are inexpensive and which reversibly bind H_2. In particular, dimeric complexes of chromium, $[(C_5H_4R)Cr(CO)_3]_2$ (R = H, CO_2CH_3, alkyl), are being studied in this project. The basic methodology used is to prepare various derivatives containing substitution on the cyclopentadienyl ligand and to screen these derivatives for reversible reaction with H_2. Once reversibility is achieved, kinetic and equilibrium data will be collected to fully characterize the system and possibly elucidate the effects of substituents on H_2 binding. Also of interest are complexes which reversibly and catalytically incorporate H_2 into an organic ketone substrate. An Rh/Sn complex which reversibly hydrogenates/dehydrogenates cyclohexanone will be discussed. Although Rh is not inexpensive, it is present in very low concentration and represents a potentially inexpensive yet selective H_2 separation method. 5 refs.

5382 **Method and apparatus for the selective separation of gaseous coal gasification products by pressure swing adsorption.** Ghate, M.H.; Yang, R.T. (to Dept. of Energy, Washington, DC). US Patent 4,696,680. 29 Sep 1987. Filed date 3 Oct 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes the method for bulk separation of multi-component gases generated in a coal gasification process wherein coal is gasified in a gasifier to produce gasification prod-

ucts including a mixture of gases comprising hydrogen, carbon monoxide, methane, and acid gas components carbon dioxide and hydrogen sulfide. It consists of the steps of conveying a stream comprising the mixture of gases into one end of an elongated column containing a solid adsorbent for each of the gases forming the mixture of gases and pressurizing the charge of gases within the column to a pressure within a range sufficient to effect the adsorption by the adsorbent of the conveyed gases including the hydrogen defining the least absorbable gas in the mixture of gases. Then, decreasing the partial pressure of the charge of gases in the column to effect the sequential desorption of the gases hydrogen, carbon monoxide, and methane from the adsorbent in the column, and conveying the adsorbed gases from the column upon desorption thereof from the adsorbent.

5383 **Conditioning of carbonaceous material prior to physical beneficiation.** Warzinski, R.P.; Ruether, J.A. (to Dept. of Energy, Washington, DC). US Patent 4,695,372. 22 Sep 1987. Filed date 15 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a method of reducing the ash content of a carbonaceous material comprising: contacting the carbonaceous material with a supercritical fluid selected from the group consisting of methanol and cyclohexane to extract a solute into supercritical phase leaving a solid residuum; separating the solid residuum into an ash reduced fraction and an ash-enriched fraction in a liquid of specific gravity selected to float the ash-reduced fraction and to permit the ash-enriched fraction to sink; recovering the solute and ash-reduced fraction as product.

0106 Properties

REFER ALSO TO CITATION(S) 5366, 5367, 6551

5384 **(DOE/OR/00033—T360) Analytical methods to characterize and quantify sulfur in coal: A review.** Nuss, E.R. (Oak Ridge Associated Universities, Inc., TN (USA)). 7 Aug 1987. Contract AC05-76OR00033. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002401/JAW.

There are a growing number of analytical methods available to industry and research for analyzing in coal. Each method is based on some unique characteristic of a particular element or compound. As greater advances are made in sulfur reduction technology, the burden of substantiating the outcomes rests on the development of analytical methods of sulfur determination. To confidently state that a process reduces sulfur, and analytical method sensitive to the forms of sulfur in both the feed and product coals must coexist with that process. Some methods for the determination of sulfur in coal, and obstacles to analysis, are presented. 12 refs., 3 figs.

5385 **(DOE/PC/70006—16) Enthalpy and phase behavior of coal derived liquid mixtures: Technical progress report for the period July-September 1987.** Yesavage, V.F.; Kidnay, A.J. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 31 Oct 1987. Contract FG22-84PC70006. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001706/JAW.

The objectives of this program are to study the enthalpy and phase behavior of a selected ternary model compound system, representative of interactions present in coal derived liquids. Measurements were made in a Freon 11 reference fluid boil-off calorimeter, and an equilibrium flash vaporization apparatus. The ternary system included an aromatic, a basic nitrogen compound, and a cresol: the m-cresol/quinoline/tetralin ternary mixture. Measurements were made over a wide range of temperature (200 to 750°F) and pressure (20 to 1500 psia), for the three pure compounds, the three binary mixtures and selected compositions of the ternary. Both enthalpy and phase behavior measurements were made. Equation of state parameters obtained from binary enthalpy data are more reliable when extrapolated to the ternary system, than parameters obtained from vapor liquid equilibrium data. Furthermore, the more complex mixing rules generally gave poorer predictions when extrapolated to ternary systems. 17 refs., 7 figs., 4 tabs.

5386 **(DOE/PC/70796—12) The effect of maceral properties on the comminution of coal: Final report, July 15, 1984-January 14, 1987.** Bodily, D.M. (Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering). 12 Aug 1987. Contract FG22-84PC70796. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87013749/JAW.

The interaction of coal with organic solvents has been studied to provide basic information important to understanding the chemical comminution of coal. Chemical comminution could occurr through physically disrupting the structure of the coal or by specific reactions with chemical functional groups in the coal. In this study, the interaction of organic solvents with coal has been studied to determine the physical changes that occur in the coal in the presence of the solvents. 56 refs., 23 figs., 3 tabs.

5387 **(DOE/PC/80530—T5) Carbon dioxide for fine coal flotation: Progress report, third quarter, second year.** Miller, J.D. (Utah Univ., Salt Lake City (USA). Dept. of Metallurgy and Metallurgical Engineering). Nov 1987. Contract FG22-85PC80530. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002648/JAW.

The hydrophilicity index from FTIR spectroscopy has been successfully used to describe the surface state of coal and hence its flotation behavior. The FTIR hydrophilicity index has been used to monitor the surface state of the coal as influenced by CO_2-pressure treatment. A controlled environment chamber was used to monitor the hydrophobicity change of fine coal during the CO_2-pressure treatment. A high-volatile bituminous (HVB) coal was selected for this purpose since the HVB coal is most amenable to the carbon dioxide coal flotation technology. Hydrophobicity for the fine coal characterized by in-situ FTIR spectroscopy increased significantly after a 50-minute treatment of dry powdered coal at a CO_2 pressure of 20 psi, and a plateau value is reached after that time. These results, demonstrate the general utility of diffuse reflectance FTIR for the characterization of hydrophobicity and the particular utility of diffuse reflectance FTIR with respect to the analysis of carbon dioxide flotation of fine coal. 3 figs.

5388 **(DOE/PC/80532—T3) On line multielement determination of coal slurries using a direct current plasma.** McCreary, T.W.; Yoon, R.H.; Long, G.L. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemistry). 30 Oct 1987. Contract FG22-85PC80532. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002458/JAW.

The method being developed for determination of sulfur in coal slurries has been further investigated and refined. All three vacuum uv wavelengths investigated were found to have adequate limits of detection and linear dynamic ranges for determination of sulfur in coal slurries of 1% and 3% coal concentration. For these lines, different aqueous standards (ammonium sulfate, thiourea, ferrous ammonium sulfate, and sulfamic acid) were found to give signals that did not differ significantly. Thus, the form of the sulfur does not appear to affect results. Potassium, sodium, calcium, and boron were investigated as potential interferents. The only interference observed was that of boron at 182.6 nm. Since boron is not a major element in coal, this is not thought to be a serious limitation for this line. Easily ionized elements do not appear to affect the sulfur emission. The recovery of signal for coal slurries was found to be less than 100%. However, the recovery was quite reproducible.

5389 **The macromolecular structure of coal.** Green, T.K. (Dept. of Chemistry and Center for Coal Science, Western Kentucky Univ., Bowling Green, KY 42101). *Journal of Coal Quality;* 6: No. 3, 90-93(Jul 1987).

Modern polymer techniques and theories have been very useful in probing both coal structure and coal-solvent interactions in recent years. Although considerable progress has been made in elucidating the macromolecular structure of coals, the work reviewed in this paper represents only a beginning. There remain serious questions about the applicability of the Flory-Rehner equation and its modifications to coals. Clearly, more progress needs to be made if we are to gain a better understanding of coal structure.

0108 Waste Management

REFER ALSO TO CITATION(S) 5368, 5369, 5376, 5402, 5692, 5693, 5694, 5695, 5696, 5697, 5698, 5699, 5700, 5702, 5900, 5901, 6157, 6451

5390 **(BNL—40141) Aerobic and anaerobic microbial dissolution of toxic metals from coal residues.** Francis, A.J.; Dodge, C.J.; Krishna, C.R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-870773—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014284/JAW.

From Workshop on biological treatment of coals; Washington, DC, USA (8 Jul 1987).

Aerobically, native autotrophic bacteria solubilized varying amounts of As, Cr, Cu, Mn, Ni, Pb, and Zn. Dissolution of the above metals was increased by severalfold when inorganic nutrients N and P were supplemented. Under anaerobic conditions native anaerobic bacteria solubilized significant amounts of Fe, Cr, and Mn when amended with carbon and nitrogen. Selective chemical extraction analyses of coal residues indicate the association of most trace metals with pyrite, Fe-oxide, and a soluble phase, possibly ferric sulfate. These results indicate that the predominant mechanism of microbial dissolution of metals from coal residues under aerobic conditions is direct bacterial oxidation of pyrite and acid production; under anaerobic conditions is due to direct bacterial reduction of iron and manganese oxides and release of trace metals coprecipitated with the oxides. 1 fig.

5391 **(CONF-870802—27) Activation of flue gas nitrogen oxides by transition metal complexes.** Miller, M.E.; Finseth, D.H.; Pennline, H.W. (Oak Ridge Associated Universities, Inc., TN (USA); USDOE Pittsburgh Energy Technology Center, PA). 1987. Contract AC05-76OR00033. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001308/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Sulfur and nitrogen oxides are major flue gas pollutants released by coal-fired electric power plants. In the atmosphere these oxides are converted to sulfuric and nitric acids, which contribute to the acid rain problem. Most of the nitrogen oxides present in coal-derived flue gas exist as the relatively inert and water-insoluble nitric oxide (NO), thus presenting a difficult removal problem. We present preliminary studies intended to establish basic homogeneous chemistry of transition metal complexes with nitrogen oxides. The transition metals considered in this work are volatile carbonyl complexes. The metal carbonyls took up nitric oxide homogeneously in the gas phase. Iron required uv light for reaction with NO, but the same result is expected with the application of heat. Metal carbonyls also reacted with nitrogen dioxide but produced polynuclear metal species. Oxygen did not attack the carbonyl or nitrosyl complexes. Results indicate high potential for NO/sub x/ removal from stack gases by sorption onto supported metal carbonyl complexes. The solid form allows ease in separation from the flue gas. Regeneration of the sorbent might be achieved by treating with CO to liberate NO/sub x/ by displacement or by heating to decompose and drive off NO/sub x/.

5392 **(PB—87-232898/XAB) Recycling seal-coat pavements with self-cementing fly ash. Phase 2, progress report No. 1.** Ferguson, E.G. (Terracon Consultants, Lenexa, KS (USA)). Apr 1987. 101p. NTIS, PC A06/MF A01.

The purpose of the proposed research is to evaluate the feasibility of recycling existing seal-coat pavements through stabilization with self-cementing fly ash. It is proposed that existing pavements can be pulverized in-place, sufficient quantities of Class C fly ash and water added, and the resulting mixture be compacted. The stabilized section could then be utilized as a base course section having greater support capacity than the original pavement section. The recycling process is intended primarily for existing pavements having up to 4 inches of asphaltic bound material underlain by a granular-base section of variable composition. The intent of the Phase II research is to establish more definitive criteria relevant to mix design and pavement thickness design for the proposed recycling process. The criteria is to be formulated through both laboratory and field tests on recycled pavements in a multistate area.

5393 **Industrial spray dryer FGD experience.** Donnelly, J.R.; Hansen, S.K.; Quach, M.T.; Farber, P.S. (Joy Manufacturing Co., Western Precipitation Div., Los Angeles, CA). pp 71-76 of Industrial power on the rebound. Woessner, P.W. New York, NY; American Society of Mechanical Engineers (1987). (CONF-861024—).

From Industrial power conference; Pittsburgh, PA, USA (4 Oct 1986).

Joy/Niro lime-based Spray Dryer Absorption (SDA) Flue Gas Cleaning (FGC) systems are in commercial operation on the following coal-fired industrial boilers: Argonne National Laboratory; General Motors - Buick Motor Division; Fairchield Air Force Base; and Malmstrom Air Force Base. The systems range in size from 41,000 to 200,000 acfm and treat flue gases from the burning of 1 to 3.5 percent sulfur coal. Each system incorporates unique site-specific design features due to differences in flue gas conditions and boiler types. This paper presents a comparison of the plant designs and performance. Compliance/performance test results are compared to design. Start-up problems are reviewed and current plant operation is discussed. Test results from high sulfur (4.2%) operation, as well as simultaneous SO/sub x//NO/sub x/ removal operation are discussed.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 5372, 5390, 5860, 5861, 5868, 6420

5394 **(CONF-870942—2) Environmental assessments of developing coal conversion technologies: Where are the data?.** Roseberry, L.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02. Order Number DE87014418/JAW.

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

A recent online search of DOE's Energy Data Base found that 50% of the public literature concerning the environment and fossil energy sources, excluding petroleum, has appeared in journals. Reports are the second major publication type with 32% of the total citations. While the journal literature discusses research issues of fossil energy, the project reports make available to the public the detailed data which is the meat of environmental assessments. The Fossil Energy Environmental, Health, and Safety Information System contains a distillation of data on industry-DOE cosponsored projects of recent years.

0120 Mining

REFER ALSO TO CITATION(S) 5399

5395 **(PB—87-227880/XAB) Industry assessment of MINOS (trade name) mine-monitoring system. Open File report, 7 July 1981-1 April 1986.** du Breuil, F.; Yingling, J.C.; Whitehead, K.L. (BCR National Lab., Monroeville, PA (USA)). Feb 1987. 100p. NTIS, PC A05/MF A01.

This report describes the installation and operation of a computer-based belt-monitoring and control system at the Barnes and Tucker Coal Co. Mine No. 20 in Ebensburg, PA. The system installed was the National Coal Board's Mine Operating System (MINOS) coal-transport monitoring and control system. The program objective was to document (1) the installation requirements for a conveyor control system, (2) the operating experience with the system, and (3) the impact of monitoring and control on mine operation. Analysis of the system operation indicates that monitoring and control did improve belt availability significiantly and reduced downtime associated with belt delays. Economic analysis showed the increased belt availability would potentially result in significant production increase and excellent payback on the initial investment. The system performed satisfactorily, was well accepted by the work force, and did not increase the maintenance workload.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 5379, 5399

0140 Combustion

REFER ALSO TO CITATION(S) 5372, 5374, 5376, 5379, 6217

5396 **(CONF-871207—3) Non-steady group combustion of a cloud of char particles.** Ramalingam, S.C.; Annamalai, K. (Texas A and M Univ., College Station (USA). Dept. of Mechanical Engineering). 1987. Contract FG22-85PC80528. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87010773/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Group theory has been recently proposed for the combustion modeling of char/carbon particles. To gain a basic understanding of the group behavior, a simple model such as the steady state analysis of a spherically symmetric cloud of char/carbon particles burning in quiescent air, was used to obtain results for the cloud burning rate. The most important objective was to relate the results from individual particle combustion (IPC) model to Group Combustion (GC) model. The present work concerns with the modeling of a non-steady (NS) group combustion of a cloud of char particles. The results presented here are for the frozen case where the gas phase CO oxidation reaction and the CO_2 reduction reaction at the char surface are suppressed. Using a computer code developed for the study of non-steady group combustion, steady state was simulated and the results were then compared with the explicit results generated in the previous work. The steady simulation was undertaken to prove the reliability of the computer model to generate transient results, as there exists no literature on transient group combustion. Secondly, the transient results for G = 100 and 10 are also presented and comparison with the steady state results for the same conditions are shown. It is found that the correction factor to the IPC model obtained with steady state group combustion theory remains approximately the same even for the NS case for G = 100. However, for G = 10, the NS results differ considerably from the quasi-steady (QS) case, due to low bulk gas temperature for dilute clouds which leads to kinetics controlled combustion, whereas the QS results are based on diffusion controlled combustion. Further, it is found that apart from the ambient temperature and the particle size, the cloud conditions also dictate whether the particles under kinetics or diffusion controlled combustion. 9 refs., 14 figs., 1 tab.

5397 **(DOE/PC/80529—T6) Effects of coal structure on pulverized coal combustion processes: Quarterly technical progress report No. 8 for the period 1 July 1987 to 30 September 1987.** Wells, W.F.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Oct 1987. Contract FG22-85PC80529. 18p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001703/JAW.

Pore size distributions were determined for the virgin coals. Carbon types were determined using NMR for the virgin coals. Extraction tests were completed. Average skeletal structure analysis was begun. A factor analysis program for use in analyzing the data was identified. The exhaust hood was removed for modification to suit the reactor and optical table configuration. Plans are also presented for the following quarterly period. 18 refs., 4 figs., 3 tabs.

5398 **(LUTMDN/TMVK—5152-1-30-1986) Converting a CFB-hotwater boiler to steam generation.** Persson, M. (Lund Univ. (Sweden). Dept. of Heat and Power Engineering). May 1986. 74p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750415/JAW.

Boilers for small coal-fired cogeneration plants have been studied. The CFB technology is examined, and technical solution for conversion of a hotwater boiler to steam generation are given. Problems of erosion, design and function of cyclones are studied, and the economy of a conversion is calculated. (L.E.).

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 5412, 5415, 5416, 5417, 5888, 5889, 5890, 5894, 5902, 5903

5399 **(DOE/EIA—0121(87/2Q)) Quarterly coal report, April-June 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 29 Oct 1987. 142p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88001962/JAW.

The Quarterly Coal Report provides comprehensive information about coal production, exports, imports, receipts, consumption, and stocks in the United States to a wide audience, including Congress, federal and state agencies, the coal industry, and the general public. The data presented in this report were collected and published by the Energy Information Administration (EIA) to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (PL 93-275) as amended. This issue shows detailed quarterly data for April through June 1987, aggregated quarterly historical and projected data for 1980 through 1988, and aggregated annual historical and projected data for 1960 through 2000. Appendix C shows detailed quarterly historical data since 1980 on coal imports, as specified in the National Coal Imports Reporting Act of 1985, Title II of the Energy Policy and Conservation Amendments Act of 1985 (PL 99-58). Appendix D presents selected quarterly tables converted to metric tons.

5400 **(SPKUS—1985-17) Economical conditions for Swedish producers of biofuels.** (Statens Pris- och Kartellnaemnd, Stockholm (Sweden)). 1985. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750406/JAW.

The economic situation for 18 companies within the biofuel sector has been investigated. 8 producers of wood chips, 8 peat producers, and 2 producers of fuel briquets. The information have been collected at personal visits at the companies. Low solidity and low results are common within this branch and some of the companies are close to go into bankruptcy. Biofuel producers that are integrated with other wood industry production are more likely to survive. (L.E.).

0160 Health And Safety

REFER ALSO TO CITATION(S) 6551

5401 **(PB—87-227898/XAB) Systems approach to mine fire safety. Open File report, 20 Jun 1980-30 June 1986.** Shibe, J.A. (National Bureau of Standards, Washington, DC (USA)). Apr 1987. 148p. NTIS, PC A07/MF A01.

The report describes a fire-safety evaluation system to be used to determine combinations of widely accepted fire-safety equipment and underground coal-mine features to provide a level of safety equivalent to that required by the U.S. Code of Federal Regulations, Title 30, for underground coal mines. In the evaluation, equivalent safety performance is gauged in terms of overall level of safety provided rather than by a component-by-component comparison.

5402 **(PB—87-234209/XAB) Investigation of the sanitation practices associated with coal-mine operations. Volume 1. Final report.** (USC, Inc., Pittsburgh, PA (USA)). 17 Oct 1974. 92p. NTIS, PC A05/MF A01.

Sanitation practices employed at surface and underground coal mines were investigated by questionnaires and on/site field observation at 126 mines. Miners and mine operators were interviewed regarding practices and areas needing improvement. Included were bath and change house facilities, drinking water, sanitary wastes, refuse disposal, and pest control. Water samples were analyzed for bacteriological quality, total and residual chlorine, and pH. Of 244 potable water (drinking and shower water) samples, 33 showed one or more coliform colonies per 100 milliliters. Drinking water provided by the company was not used by 257 of 454 under-

ground miners and 52 of 201 surface miners. Underground toilet facilities were infrequently used. At surface mines, facilities were used more often. Solid waste was generally not found to present a health hazard. A manual of good practices was developed, and recommendations for changes in regulations were made.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 5399, 5885

02 PETROLEUM

0201 Reserves

5403 **(DOE/EIA—0216(86)) US crude oil, natural gas, and natural gas liquids reserves: 1986 annual report.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 15 Oct 1987. 99p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. Order Number DE88002160/JAW.

This report presents estimates of proved reserves of crude oil, natural gas, and natural gas liquids as of December 31, 1986, for the total United States and for selected states and state subdivisions as well as production volumes for the year 1986. Also included is information on indicated additional crude oil reserves, oil and gas reserves in nonproducing reservoirs, and lease condensate reserves and production. These estimates are based upon data obtained from two annual EIA surveys. Data are also presented on notable oil and gas exploration and development activities during 1986. 26 refs., 9 figs., 15 tabs.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 5896

0203 Drilling And Production

REFER ALSO TO CITATION(S) 5997

5404 **(DOE/SF/11564—25, pp 1-24) Flow properties study.** Wang, J.; Coblentz, J.F. Aug 1987. NTIS, PC A07/MF A01. Order Number DE87001255/JAW.

In SUPRI heavy oil research program: Tenth annual report for the period October 1, 1985-December 31, 1986.

The purpose is to assess the effects of temperature and pressure on relative permeability to oil and water, and capillary pressure in petroleum reservoirs; and to correlate the data obtained in the laboratory with those at reservoir conditions. During the past year, the high temperature relative permeability apparatus has been redesigned to make the volume produced measurements more accurate and to reduce the dead volume of the system. Also the core holder has been changed so that higher temperature appears to be possible. Early results indicate that the absolute permeability to water decreases with a rise in temperature. These results were in agreement with some research work, but differ from other work. The recent effort shows that the absolute permeability to water seems to be dependent on whether the core is fired or not. This was found even with Ottawa sand cores. Measurements were made of relative permeabilities to oil and water at moderate temperature for unconsolidated sands; results indicate that oil-water relative permeabilities are temperature-independent between 20C and 90C. Recent data extends this temperature range to 148C with the same results. In Berea cores, only the end point relative permeabilities and saturations could be measured. This work will be continued and extended to crude oils and other rocks.

5405 **(DOE/SF/11564—25, pp 25-54) In-situ combustion.** de los Rios, C.; Baena, C.; Wingard, J. Aug 1987. NTIS, PC A07/MF A01. Order Number DE87001255/JAW.

In SUPRI heavy oil research program: Tenth annual report for the period October 1, 1985-December 31, 1986.

The goal of this project is to evaluate the different parameters affecting combustion field projects, including the study of the reaction kinetics of combustion in the presence of reservoir matrix and crude oil. Present work focuses in three main directions: (1) on the various processes that lead to fuel deposition (with emphasis on the cracking and coking zone and the role of metals on the kinetics of fuel deposition reactions); (2) laboratory simulation of combustion processes with and without water soluble metallic compounds to verify the effect of such salts on the process variables of in-situ combustion; and (3) methods of automating the experimental apparatus and data gathering for both types of experiment. The effect of CO_2 is being studied for systems including steam and heavy oil at high pressure and temperature. The approach is analytical, whereby the equations defining the flow, the equilibrium relationships, and the enthalpies are combined into a set of Buckley-Leverett type equations which can be solved simultaneously. Such solutions form a matrix of possible frontal velocities which must be identified. 20 references, 11 figures, 3 tables.

5406 (DOE/SF/11564—25, pp 55-91) **Steam injection with additives.** Wang, F.; Maneffa, M.; Mahmood, S.; Farrell, J.; Fernandez, E.; Erickson, A. Aug 1987. NTIS, PC A07/MF A01. Order Number DE87001255/JAW.

In SUPRI heavy oil research program: Tenth annual report for the period October 1, 1985-December 31, 1986.

The purpose of this project is to develop a process allowing mobility control in steam drives in order to reduce gravity override and channeling of steam, primarily by use of surfactants/foams, and to understand the nature of the flow for such systems. Research in the past has aimed at answering several basic questions: (1) what are the criteria for foam generation and propagation in porous media and how stable are such systems; (2) what is the degree of surfactant partitioning and adsorption in porous media under reservoir conditions; (3) what is the phase interaction between aqueous surfactant solution and oil; and (4) what is the mobility of a surfactant-gas system in porous media and what are the mechanisms governing the flow of such systems. Recent efforts have centered on several aspects of basic understanding of foam flow. At low pressure and room temperature, this includes: (1) work on a new micromodel which has oil, gas and surfactant solution all included, (2) equation development for defining two-dimensional (x, z) foam flow, (3) the beginnings of work on the transient behavior of foam as it moves through a porous system, and (4) the study on the relative effects of emulsification ability versus foaming ability on surfactant flow and displacement. At high temperature and pressure the focus has been: (1) a study of the heat transfer characteristics of laboratory systems; (2) a new formulation for the critical time for steam injection and the heating efficiency; (3) a study of the effect of foaming agents and nitrogen on the effective mobility of steam. The last study is far from complete. 24 references, 19 figures, 2 tables.

5407 (DOE/SF/11564—25, pp 92-108) **Reservoir definition.** Ambastha, A.; Ahmed, G.; Riley, M. Aug 1987. NTIS, PC A07/MF A01. Order Number DE87001255/JAW.

In SUPRI heavy oil research program: Tenth annual report for the period October 1, 1985-December 31, 1986.

The main purpose of this project is to improve the techniques of well-to-well formation evaluation such as tracer tests and pressure transient tests, and to facilitate the interpretation of such tests. On well testing, a study is being made of the pressure derivative technique for analyzing well tests. Of particular importance are cases of high mobility ratio and high compressibility which are the types of systems found in thermal recovery. Another study has found a way to detect faults in many cases where heretofore they could not be detected. Also a study has begun on analytically solving the flow to perforations. This is a difficult problem whose solution is not immediately apparent. An exact solution has been developed for the single well tracer test technique. This solution requires complex integrations to be evaluated and it is being compared with the approximate solutions developed by Antunez several years ago. The effect of reservoir heterogeneity on well-to-well tracer flow behavior is being studied. Preliminary results are fascinating. Depending on the nature of the heterogeneities, the result may look

like pseudolayering, or it may look like a larger dispersion coefficient. 16 references, 5 figures, 2 tables.

5408 (DOE/SF/11564—25, pp 109-119) **Field support services.** Ramage, W.; Barua, J.; Baena, C. Aug 1987. NTIS, PC A07/MF A01. Order Number DE87001255/JAW.

In SUPRI heavy oil research program: Tenth annual report for the period October 1, 1985-December 31, 1986.

The purpose is to provide technical support in design and monitoring of enhanced oil recovery field experiments. Studies are in progress on the economics of thermal recovery and on optimization of cyclic steam injection. The study on the economics indicates that the assumed price range of oil can have a marked effect on the resulting optimum spacing. The study of steam cycling optimization shows that different operating scenarios may be better than are presently used. A number of US and foreign visitors have come to the laboratories to discuss their laboratory and field projects. This is an important aspect of our research for such visits help disseminate our results. 4 references, 2 figures, 1 table.

0204 Processing

REFER ALSO TO CITATION(S) 5371, 5425

5409 (AD-A—184229/3/XAB) **Electronic factors in thiophene adsorption and hydrodesulfurization on MoS_2 surfaces. Technical report.** Zonnevylle, M.G.; Hoffman, R. (Cornell Univ., Ithaca, NY (USA). Lab. for Atomic and Solid State Physics). Jul 1987. 7p. (TR—35). NTIS, PC A02/MF A01.

Hydrodesulfurization, the removal of sulfur in the form of H_2S from petroleum compounds, is a crucial step in industrial-refinement processes. In spite of numerous recent experimental and theoretical studies, many aspects of the complex HDS system remain obscure. We will focus on the MoS_2/thiophene system in this work. MoS_2 based systems are among the most frequently used and studied catalysts. The microscopic nature of the active surface is not well defined, although several points can be made. Crystallites of the material are bound to an Al_2O_3 support, which is generally considered to be inert. MoS_2 is a layer compound; the crystals cleave readily between the S-Mo-S sandwiches to expose all-sulfur faces. However, this surface, the basal plane, is believed to be inactive in HDS. The catalytic surface contains exposed Mo atoms. A good candidate is the edge plane perpendicular to the sulfur layers. Corner sites along the edge and defect sites arising from missing surface sulfur atoms, in particular, have been implicated as the active sites. These Mo atoms are coordinatively unsaturated, thus it is not unreasonable that adsorption may occur here.

5410 (DOE/CE/15303—T3) **Evaluation of the economic feasibility of commercial use of Mr. Victor Thayer's invention process and apparatus for reducing the energy required to separate liquids by distillation.** (TENSA Services, Houston, TX (USA)). Jul 1987. Contract FG01-87CE15303. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000376/JAW.

The possible application of Mr. Victor R. Thayer's invention for reducing distillation energy requirements (US Patent Number 4,267,736) to a clean distillation duty has been evaluated. A suitable test system (C_2 splitter in an olefins plant) was selected and simulated using a computer model. Costs were derived for Mr. Thayer's apparatus, and these were compared with those of an established competing technology. The operability and maintainability of the Thayer system were also evaluated. The overriding conclusion from this study is that Mr. Thayer's invention, when applied to the test system, carries a higher capital cost and greater maintenance overheads than established technologies, without offering any significant scope for improving efficiencies or reducing operating costs. It is therefore effectively ruled out for revamp applications and is unlikely to be widely useful in new plants of this type. However, the study has indicated that there may be some specialized duties, such as those involving separation of toxic or corrosive liquids, or where plot area is a constraint, or the heat transfer area requirements are small, that favor the use of the Thayer invention. Future effort should therefore be directed into identifying applications of these types, and into reducing the cost of the heat transfer coils required for Mr. Thayer's invention. 2 tabs.

5411 (UCRL—97248) **The effect of prehydrogenation on the hydroconversion of Maya residuum: Part 1, Process characterization.** Reynolds, J.G.; Beret, S. (Lawrence Livermore National Lab., CA (USA); Chevron Research Co., Richmond, CA (USA)). Oct 1987. Contract W-7405-ENG-48. 26p. (CONF-871176—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001635/JAW.

From Annual meeting and conference on biotechnology; New York, NY, USA (15 Nov 1987).

Maya 650°F residuum was subjected to mild prehydrogenation over a standard, commercially available, hydrodesulfurization catalyst. The product was then distilled to yield hydrogenated Maya 650°F residuum. This prehydrogenated residuum, and the untreated Maya 650°F residuum were separately hydroprocessed further at different process severities. The resulting products were then examined by elemental analyses to determine the effects of the prehydrogenation step on overall conversion and product quality. The primary effect of the prehydrogenation step was to increase the overall conversions for all measured properties of the hydroconversion products. As a result, the hydroconversion products derived from the prehydrogenation were substantially better quality than the corresponding direct hydroconversion products. The prehydrogenation step also lowered the severity required for equivalent residuum hydroconversion upgrading. 38 refs., 6 tabs.

0205 Products And By-products

REFER ALSO TO CITATION(S) 5945

0206 Health And Safety

REFER ALSO TO CITATION(S) 5421

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 5897, 5906, 5907, 5908, 5909

5412 (DOE/EIA—0035(87/07)) **Monthly energy review, July 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 26 Oct 1987. 143p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88002158/JAW.

This volume presents statistical data on the production and consumption of energy in the United States for the month of July 1987. Special attention is given in this volume to residential consumption. (JDH)

5413 (DOE/EIA—0109(87/07)) **Petroleum supply monthly, July 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 24 Sep 1987. 115p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88002155/JAW.

This report presents statistical data on the sources and supplies of petroleum and petroleum products. This volume features articles on heating oils, including an outlook for winter 1987. (JDH)

5414 (DOE/EIA—0109(87/08)) **Petroleum supply monthly, August 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 23 Oct 1987. 126p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88002156/JAW.

This report presents statistical data on the sources and supplies of petroleum and petroleum products. This volume features articles on US petroleum exports. (JDH)

5415 **(DOE/EIA—0202(87/4Q)) Short-term energy outlook: Quarterly projections, October 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Oct 1987. 58p. NTIS, PC A04/MF A01 - GPO; 1; GPO Dep. Order Number DE88002150/JAW.

This volume presents petroleum marketing data for the reporting period. As worries over crude oil prices eased during the third quarter of 1987, other concerns heated up - namely, the weather. Cooling degree days, which were 7% above last year during the summer months of June, July, and August, kicked up total electricity generation by more than 5% over the corresponding period of 1986. As a result, generation from coal, gas, and nuclear rose substantially, and even oil-fired generation posted a smaller-than-expected decline. Now that the summer peak is over, attention is shifting to heating oil supplies for the coming winter, with distillate stocks some 24 million barrels below last year's pre-winter level.

5416 **(DOE/EIA—0219(86)) International energy annual, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 13 Oct 1987. 126p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88002157/JAW.

The International Energy Annual presents current data and trends for production, consumption, stocks, imports, and exports for primary energy commodities in more than 190 countries, dependencies, and areas of special sovereignty. Also included are prices on crude petroleum and petroleum products in selected countries. This report is published to keep the public and other interested parties fully informed with respect to primary energy supplies on a global basis. The data presented have been largely derived from published sources and from United States Embassy personnel in foreign posts. The data have been converted to units of measurement and thermal values familiar to the American public.

5417 **(DOE/EIA—0376(85)) State energy price and expenditure report, 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 21 Oct 1987. 240p. NTIS, PC A11/MF A01 - GPO; 1; GPO Dep. Order Number DE88002306/JAW.

The State Energy Price and Expenditure Report (SEPER) presents energy price and expenditure estimates for the 50 States, the District of Columbia, and the United States. The estimates are provided by energy source and economic sector. Documentation follows the tables and describes how the price estimates are developed, including sources of data, methods of estimation, and conversion factors applied. The average price paid for energy in the United States in 1985 was $8.50 per million Btu, up slightly over the 1984 average of $8.43 per million Btu. While total energy consumption held steady at 74 quadrillion Btu from 1984 to 1985, expenditures rose from $439 billion to $441 billion. Of the major energy sources, electricity registered the highest price per million Btu ($19.85), Followed by petroleum ($7.56), natural gas ($4.60), coal ($1.69), and nuclear fuel ($0.70).

5418 **(DOE/EIA—0380(87/07)) Petroleum marketing monthly, July 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 5 Oct 1987. 215p. NTIS, PC A10/MF A01 - GPO; 1; GPO Dep. Order Number DE88002151/JAW.

The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 5868, 6420

5419 **(AD-A—184442/2/XAB) Disturbance and recovery of arctic Alaskan tundra terrain. A review of recent investigations. Report for 1976-1983.** Walker, D.A.; Cate, D.; Brown, J.; Racine, C. (Army Cold Regions Research and Engineering Lab., Hanover, NH (USA)). Jul 1987. 72p. (CRREL—87-11). NTIS, PC A04/MF A01.

This report summarizes over a decade of CRREL-managed research regarding disturbance and recovery in northern Alaska. Themes emphasized include: 1) Most anthropogenic disturbances have natural analogs, which can provide much inexpensive information that can be related to modern disturbances and their rates of recovery. 2) Most single-event disturbances will heal and develop a functioning ecosystem within a human life span, but a return to the original ecosystem can rarely be expected for major impacts. 3) The concept of recovery must be based on consistent terminology that recognizes the distinction between ecosystem resistance (the ability to withstand impact) and resilience (the ability to return to the previous undisturbed state) and also the distinction between complete recovery (a return to the original ecosystem) and functional recovery (the development of a functional ecosystem different from the original). In permafrost regions with massive ground ice, recovery of the vegetation is limited by alterations to the permafrost regime.

5420 (ESA-SP—258, pp vp) **Remote sensing investigation of the oil spill in the Messina Strait, Italy.** Geraci, A.L.; Larosa, G.; Delre, L. (Italian Navy, Spezia). Dec 1986. NTIS, PC A14/MF A01. (ETN—87-90155; CONF-8606354—).

From ESA-EARSel Europe from space symposium; Lyngby, Denmark (25 Jun 1986).

The usefulness and applicability of remote sensing to oil spill control, in order to save money on the cleanup costs and to limit the damage to natural resources is demonstrated. Two tankers collided, spilling 1000 tons of oil near the Italian coast. Although boats and aircraft encountered problems in locating the slicks, experience gained in helicopter remote sensing for the control of marine pollution was refused by the authority in charge. So the investigation was carried out using infrared photography and LANDSAT MSS data only. The results indicate that if remote sensing techniques had been used on a regular basis the damage would have been less.

5421 **(IVL-B—816) Air pollution aspects on oil discharge at sea - a review.** Ferm, M.; Lehtinen, C.; Lindskog, A. (Swedish Environmental Research Inst., Stockholm). Apr 1986. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750417/JAW.

The report discusses the input and composition of petroleum oils into the marine environment with special emphasis on factors influencing evaporation rates. Estimations of the atmospheric concentration distribution of hydrocarbons around an oil spill are given, and a simple model for calculation of such distributions is presented. The importance of evaporated oil form surface slicks is correlated to other emissions of organic compounds in a global atmospheric budget for such substances and the chemical transformation of gaseous hydrocarbons in the atmosphere is discussed. It is concluded that the contribution of hydrocarbon evaporation from oil slicks to the photochemical oxidant pollution is neglectable. The damage caused to humans and the environment on shore is also neglectable in most cases, whereas the human health hazard can be considerable in the close vicinity of the spill. (authors). With 35 refs, 4 tables and 7 figures.

0220 Transport, Pipelines, And Handling

5422 **(PB—87-228946/XAB) Reliability evaluation of subsea pipelines.** Hokstad, P.R. (SINTEF, Trondheim (Norway)). 4 Feb 1987. 54p. (STF—75-A87005). NTIS, PC E04/MF E04.

General aspects of an availability study for a system of subsea oil/gas pipelines are considered. A rather extensive list of the existing literature, related to availability of pipelines is provided. Based on the literature study, the various steps in an availability analysis are discussed, and some reliability data are summarized. Several results, being relevant for an availability study of a subsea pipeline system, have been obtained during the last few years. However, some areas for further work, will be identified. A somewhat simplified approach for assessing the overall availability is also discussed. This could serve as an attractive alternative to applying the more-complex theory of flow networks.

0230 Properties

REFER ALSO TO CITATION(S) 5899

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 5403

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 5412, 5415, 5416, 5417, 5897, 5898, 5935

5423 **(DOE/EIA—0145(86)) Statistics of interstate natural gas pipeline companies, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 29 Oct 1987. 257p. NTIS, PC A12/MF A01 - GPO; 1; GPO Dep. Order Number DE88002307/JAW.

Financial and operating information are presented of all major interstate natural gas pipelines that operated in the United States during 1986. This report indicates that the 43 major interstate natural gas pipeline companies reported assets totaling $54.5 billion, as of December 31, 1986, compared with $60.1 billion on December 31, 1985. In some instances throughout this discussion of financial and operating information, comparative data for 1985 are indicated in parentheses following the amounts shown for 1986. Gross gas utility plant investments at the end of the year amounted to $43.1 billion ($43.7 billion); and net gas utility plant assets amounted to $19.3 billion ($20.7 billion). The major pipeline companies reported total gas operating revenues of $33.5 billion ($49.0 billion). Sales of natural gas decreased from 11.3 trillion cubic feet in 1985 to 7.8 trillion cubic feet in 1986. Sales of natural gas to ultimate consumers decreased from 1.4 trillion cubic feet in 1985 to .7 trillion cubic feet in 1986. Sales to other gas utilities decreased from 9.9 trillion cubic feet in 1985 to 7.1 trillion cubic feet in 1986. Revenues from these sales to ultimate consumers decreased from $6.5 billion in 1985 to $3.1 billion in 1986. Revenues from sales for resale to other gas utilities amounted to $26.7 billion in 1986 and $38.5 billion in 1985. 5 figs., 21 tabs.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 5868

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 5422

0340 Combustion

REFER ALSO TO CITATION(S) 5980

5424 **(PB—87-235701/XAB) Basic research on pulse-combustion phenomena. Final report, November 1983-June 1987.** Creamer, K.S.; Corliss, J.M. (Battelle Columbus Div., OH (USA)). 20 Aug 1987. 57p. NTIS, PC A04/MF A01.

See also annual report for November 1984-November 1985, PB—86-203221.

The overall objective of the program is to study the basic fluid mechanics, kinetics, and pollutant-formation phenomenon occurring in pulse-combustion systems. The objective of the third year was to probe deeper into the effect of timing on combustor operation. Of interest was the effect of fuel-entry timing, air-entry timing, premixing, and frequency on combustor operation. Fuel-injection timing was found to affect the air-pumping capacity of the pulse combustor because of the change in the relationship of heat release and pressure oscillations. Pumping capacity is reduced when fuel injection occurs continuously over the cycle. Air-valve design will affect the period during which air enters the mixing chamber. Premixing of fuel and air does not have a significant affect on combustor operation in the middle of the operating range of the combustor. However, it may delay the onset of incomplete combustion as the equivalence ratio approaches 1.0. It also reduces the minimum firing rate at which the combustor will operate.

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 5383

5425 **(AD-A—184059/4/XAB) Turbine fuels from tar sands bitumen and heavy oil. Volume 1. Phase 3. Pilot plant testing, final design, and economics. Final report, 1 June 1985-31 March 1987.** Talbot, A.F.; Carson, T.C.; Magill, L.G.; Swesey, J.R. (Sun Refining and Marketing Co., Marcus Hook, PA (USA)). Aug 1987. 130p. NTIS, PC A07/MF A01.

Pilot-plant-scale demonstration of an upgrading/refining scheme to convert bitumen or heavy crude oil into high yields of specification-quality aviation turbine fuel was performed. An atmospheric residue from San Ardo (California) crude was converted under hydrovisbreaking conditions to synthetic crude for further refining. Naphtha cuts from the straight run and synthetic crude were combined, catalytically hydrotreated, then hydrocracked. Products from these operations were combined to produce two prototype specification fuels (JP-4 and JP-8) as well as two heavier, variable-quality fuels. An engineering design (Volume II) was developed for a 50,000 BPSD grass-roots refinery, from the pilot-plant operations. Capital investment and operating costs were estimated, and fuel manufacturing costs projected. Conclusions and recommendations for further work are included.

5426 **(DOE/FE/60177—2438) Design, testing, and operation of a plug-flow, inclined fluidized bed reactor.** Merriam, N.W.; Cha, Chang Yul. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-83FE60177. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001704/JAW.

This report describes the design, testing, and initial operation of a plug-flow, fluidized bed reactor. The reactor is designed to overcome the problem of nonuniform residence times of particles having different sizes, which is common when using conventional, vertical, fluidized beds. Cold-flow tests using solid tracers have verified that the inclined fluidized bed is a plug-flow reactor. The reactor retains the desirable characteristics of fluidized beds such as high heat transfer rates, good mixing, high throughput, and no moving parts, while it also has the capability for uniform residence times of different-sized particles and nonisothermal operation. Combustion tests show the reactor is capable of burning 96 to 99% of the organic carbon from oil shales containing 6.2 to 13.9 wt % organic carbon and 76% from retorted shale containing 2.9 wt % organic carbon. Retorting tests using eastern shale with steam produce very heavy, viscous oil that does not flow from the present oil collection equipment. Oil would not flow from collection equipment during shakedown tests of the combined retort and combustor system with eastern and western shale retorted with pyrolysis gas. Yields were estimated from spent shale analyses at 103 and 114% of Fischer assay for tests using western and eastern shales. Recommendations are made for improvements in the oil collection equipment and future tests. Provision should be made to separate and remove heavy oil above its pour point. A factorial

matrix of tests to study residence time, gas composition, and bed temperature is recommended. 14 refs., 10 figs., 10 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 5426

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 5394

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

5427 **(INIS-BR—899) Influence of some ions on the apatite flotation of Itataia ore.** Aquino, J.A. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). [1987]. 15p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700659/JAW.

The production process by flotation for uranium phosphor ore in Itataia-Ce, Brazil is shown. A flotation scheme with mass balance and characterization on the samples is analyzed. The analysis methods with some results of concentration effect of Ca/sup 2+/, Mg/sup 2+/, Cl/sup -/ e Na/sup +/ in the direct flotation are demonstrated. (M.J.C.).

0505 Uranium Enrichment

5428 **(EUR—10743) Advanced uranium enrichment processes.** Clerc, M.; Plurien, P. (Commission of the European Communities, Luxembourg). 1986. 186p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750624/JAW.

Three advanced Uranium enrichment processes are dealt with in the report: AVLIS (Atomic Vapour LASER Isotope Separation), MLIS (Molecular LASER Isotope Separation) and PSP (Plasma Separation Process). The description of the physical and technical features of the processes constitutes a major part of the report. If further presents comparisons with existing industrially used enrichment technologies, gives information on actual development programmes and budgets and ends with a chapter on perspectives and conclusions. An extensive bibliography of the relevant open literature is added to the different subjects discussed. The report was drawn up by the Nuclear Research Centre (CEA) Saclay on behalf of the Commission of the European Communities.

5429 **Application of sequential probability ratio test to uranium enrichment verification.** Pratt, J.C.; Close, D.A. (Los Alamos National Lab., NM, USA). *Nuclear Instruments and Methods in Physics Research;* **258**: No. 2, 255-260(1 Aug 1987).

The sequential probability ratio test is a statistical process capable of quickly and accurately verifying the uranium enrichment in the header pipes of uranium centrifuge enrichment facilities. The test minimizes the time required for a measurement, making a complete verification possible in 15-30 min.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 5548, 5713, 6039, 6040

5430 **(AD-A—184032/1/XAB) Documentation and analysis of IAEA (International Atomic Energy Agency) safeguards implementation at the Exxon Nuclear Fuel Fabrication Plant. Final report.** Schneider, R.A. (Exxon Nuclear Co., Inc., Richland, WA (USA)). Oct 1984. 59p. (XN-NF—84-86). NTIS, PC A04/MF A01.

The Exxon Nuclear low-enriched uranium fuel fabrication plant in Richland, Washington was the first US bulk handling facility to be selected by the International Atomic Energy Agency (IAEA)for inspection. This report documents and analyzes the implementation of IAEA safeguards at the plant. Between March 1981 and November 1983, 12 IAEA inspections were carried out, including three physical inventory verifications. Inspection activities included verification measurements of flow and inventory items and records audits. The effectiveness and degree of independence of the IAEA's verification measurements increased during the period as additional verification capabilities were put into use by the inspectors. Operational efficiency also increased with experience and as the result of cooperative efforts by the operator and inspector. Those efforts also resulted in the development of innovative approaches for improving effectiveness and minimizing the cost burden. The experience showed that IAEA safeguards can be technically effective, operationally efficient, and not overly burdensome to the plant operator. A cooperative non-adversarial approach was found to be the best approach for success.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 5546, 5815

5431 **(RFP—3945) Plutonium recovery from spent direct oxide reduction salts by chloride anion exchange.** Muscatello, A.C.; Fisher, D.C.; Kazanjian, A.R.; Navratil, J.D.; Stevens, J.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 17 Jul 1987. Contract AC04-76DP03533. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002475/JAW.

Chloride anion exchange has been investigated for recovery of plutonium from Direct Oxide Reduction (DOR) waste salts. Limited experimental results indicate that the conditions for $<10^{-3}$ g/l losses of plutonium to effluents are feed adjustment to >8.5M total chloride, including 1.0M HCl + 0.05M $NaNO_2$; a wash solution of 8M HCl + 0.05M $NaNO_2$; elution with 0.5M HCl and use of Amberlite IRA-938 for the anion exchange resin. These conditions result in >99% recovery of the plutonium. The eluate also contains ~200 ppM calcium. Oxalic acid precipitation of Pu(III) recovers 99.2% if the molar ratio is 6:1 and the acidity is 0.8M. After calcination, the resulting plutonium oxide is suitable for DOR recycle if blended. Also, in the investigation, limited studies of extraction chromatography showed unacceptable plutonium losses to effluents.

5432 **(RFP—4115) Process Chemistry Technology: Annual progress report, October 1, 1985-September 30, 1986.** Crisler, L.R.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 3 Jul 1987. Contract AC04-76DP03533. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002484/JAW.

Research activities are reported for the following RFP groups: product physical chemistry, process chemistry, pyrochemistry technology, and aqueous recycle technology. (DLC)

0509 Transport And Storage

REFER ALSO TO CITATION(S) 6235

5433 **(EUR—10731) Stowing of packages containing radioactive materials during their road transportation with trucks for loads up to 38 tons.** Gilles, P.; Chevalier, G.; Pouard, M.; Jolys, J.C.; Draulans, J.; Lafontaine, I. (Commission of the European Communities, Luxembourg). 1986. 190p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750623/JAW.

A compilation and a coordination of available standards, regulatory prescriptions and directives on stowing are first presented. Then generated forces resulting from road vehicle deceleration in accidental conditions are searched. The investigation shows that higher dangerous materials transportation probabilities essentially concern front end impacts (51.4 %) and side on impacts (19 %). These accidents occur with a speed of about 80 km/h before the impact and 50 km/h during the crash. During the latter, deceleration values ranging from 20 to 100g could be reached, the mean

value could be about 30g. A mathematical model is developed. Experiments are realized with the aims on the one hand, to verify the results obtained from a mathematical model of accident and on the other hand to collect experimental values allowing to work out a code of good practice for the stowing of radioactive materials packages having a maximum weight of about 20 tons. A number of 8 tests has been performed with two types of packagings: lower and higher centre of gravity in front end and side on impacts. In case of a front end impact, the stowing system must be able to absorb entirely the kinetic energy generated by the package deceleration. This means that a tie-down system according to the 2g - 1g - 1g standard is convenient provided that the package is chocked in the direction of the traffic. The damage is proportional to the weight of the vehicle responsible for such side on impact. This weight could be much higher than the package weight. Deceleration values up to 120g have been recorded. As a result, the tie down system similar to the 2g - 1g - 1g standard is convenient, but chocks acting perpendicularly to the direction of the traffic are to be prohibited.

5434 **(KFK—4218) Directions for the choice of the transport modalities for the transport of radioactive materials on public roads.** Berger, H.U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Jul 1987. 395p. (In German). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88751029/JAW.

Report: 29 p., annexes: 366 p. .

This report shall be a help for scientific and technical personal of the nuclear research center in the choice of the modalities of the transport of radioactive materials on public roads in accordance to regulations and authorizations. Not only the Atomic Law, the Radiation Protection Ordinance and the Ordinance on Dangerous Goods on Roads, which are binding in any case, are regarded in this report but also as the scope and the impositions of the transport authorizations of the nuclear research center as the internal instructions of the nuclear research center. The reader is guided by dialogue (pretty much as a book for 'programmed learning') to the solution of his special problem of transport. In order to narrow down the size of this report, all technical or administrative details are treated in eleven brochures, which are published as technical supplements of this report.

5435 **(PNL—6342) RADGEN: A radiation exchange factor generator for rod bundles.** Rector, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002958/JAW.

The RADGEN computer program has been developed at Pacific Northwest Laboratory (PNL) to generate input required for the thermal radiation models used in the COBRA-SFS (Spent Fuel Storage) computer program. The COBRA-SFS program uses radiation exchange factors to describe the net amount of energy transferred from each surface to every other surface in an enclosure. The RADGEN program generates radiation exchange factors for arrays of rods on a square or triangular pitch as well as open channel geometries. This report describes the input requirements for the RADGEN code, which may be executed in a batch or interactive mode, and outlines the solution procedure used to obtain the exchange factors. 4 refs., 25 figs., 13 tabs.

5436 **(SAND—85-0196) Thermal measurements in a series of large pool fires.** Gregory, J.J.; Mata, R. Jr.; Keltner, N.R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 141p. (TTC—0659). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE87013196/JAW.

During the summer of 1983, Sandia National Laboratories (SNL) conducted a series of pool fire tests in which the test item was a 5-ft-dia, 21-ft-long, mild steel calorimeter that weighed ~11 tons. The purpose of these tests was to study the thermal response of a large test item in a specified fire configuration, to define thermal boundary conditions, and to assess the repeatability of the fire environment. The calorimeter was used to simulate a nuclear waste transportation cask in both a geometric and thermal sense. The test program and initial evaluations were funded by the Federal Rail Administration of the US Department of Transportation (DOT). Additional evaluations and the production of this report were supported by the US Department of Energy (DOE). This project was directed by the Transportation Technology Center at SNL. 21 refs., 121 figs., 6 tabs.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 5485, 5490, 5497, 5498

0520 Waste Management

REFER ALSO TO CITATION(S) 5432, 5550, 5682, 5754, 5815, 5995, 6062, 6207, 6241, 6241, 6483, 6490, 6492, 6493, 6501

5437 **(BNL—40349) Progress in development of an accelerated leach test for low-level radioactive waste forms.** Fuhrmann, M.; Pietrzak, R.; Dougherty, D.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 13p. (CONF-870859—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002121/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Factors that accelerate leaching from solidified low-level radioactive waste are being investigated to develop a short-term leach test that can be used to predict long-term releases. Data from work with portland cement containing radioactive tracers indicate that elevated temperatures can accelerate leaching of Ce-137 by at least a factor of eleven without changing the leaching mechanism. An 18 day leach test at 50°C provided the equivalent of 200 days data taken at 20°C. Portland cement containing 5 wt % Na_2SO_4 also can be accelerated, but to a lesser degree. Solid phase analysis indicated that pore plugging and increased tortuosity may be the cause of the smaller acceleration. Reduced specimen size was also a useful acceleration factor with inhomogeneities not being a problem in very small specimens. Elevated pH and 100 ppM EDTA in leaching solutions increased Sr-85 releases without altering Cs-137 leaching. 9 refs., 10 figs., 1 tab.

5438 **(BNL—40350) Solidification of commercial and defense low-level radioactive waste in polyethylene.** Franz, E.M.; Heiser, L.H.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 16p. (CONF-870859—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001553/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A process was developed for the solidification of salt wastes, incinerator ash and ion-exchange resins in polyethylene. Of the salt wastes, sodium sulfate and boric acid are representative of the wastes produced at commercial nuclear facilities while sodium nitrate in a typical high-volume waste generated at defense-related facilities. Ease of processibility and high loading efficiencies were obtained through the use of low-density polyethylene with melt indices ranging from 2.0 to 55.0 g/minute. The process utilized a commercially available single-screw extruder to incorporate the wastes into the polyethylene at about 120°C to produce a homogeneous mixture. Although present studies utilize dry wastes, wet wastes can also be processed using vented extruders of the type used commercially for the bitumen solidification process. Tests were performed on the waste forms to determine leachability and mechanical properties. To confirm the compatibility of polyethylene and nitrate salt waste at elevated temperatures, the self-ignition temperatures were measured and a differential scanning calorimeter was used to characterize the thermal behavior of oxidizing compounds contained in the simulated waste, as well as the real Savannah River Plant waste. No exothermic reactions were observed over the temperature range studied from 50°C to 400°C. 18 refs., 7 figs., 8 tabs.

5439 **(BNL—52078) Solidification of problem wastes: Annual progress report, October 1985-September 1986.** Franz, E.M.; Heiser, J.H. III; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Feb 1987. Contract AC02-76CH00016. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001584/JAW.

This report describes initial work on the development of solidification systems for sodium nitrate waste and compacted waste. Sodium nitrate waste has been solidified in three types of materials: polyethylene, polyester-styrene (PES), and latex cement. Evaluations of the properties of the waste form, such as the ANS 16.1 leaching test, water immersion test and compressive strength measurements were performed on the waste forms containing various amounts of sodium nitrate. 9 refs., 9 figs., 7 tabs.

5440 (CONF-860990—Summ., pp 1-5) **Low-level radioactive waste management: five years of progress - a future of significant challenge.** Barainca, M.J. (Dept. of Energy, Idaho Falls, ID). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

This paper presents the personal perspective of the author as he departs the DOE Low-Level Waste Management Program. Past accomplishments by the low-level waste management community are presented along with a personal view of what challenges the future may hold for both the commercial and DOE low-level waste management sectors.

5441 (CONF-860990—Summ., pp 6-16) **Recent international developments in low-level waste disposal.** Mitchell, S.J.; Lakey, L.T.; Harmon, K.M. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Recent international developments in low-level wastes (LLW) disposal have included a move away from ocean dumping and a trend towards engineered and deeper disposal. Siting efforts have accelerated as interim storage facilities and existing sites reach capacity. The suspension of ocean dumping by the London Dumping Conventions of 1983 and 1985 has affected the LLW disposal practices of several countries, including the United Kingdom, Belgium, the Netherlands, Switzerland, and Japan. Their plans now include disposal in trenches, shallow concrete pits, deep mines, subseabed caverns, horizontal mountain tunnels, and long-term storage facilities. Other recent developments include selection of the semi-desert Vaalputs site in South Africa, licensing activities for the Konrad mine site in the Federal Republic of Germany, design of at-reactor sites in Finland, and construction of a Baltic Sea site in Sweden. Also, the French have recently selected the Aube site for engineered disposal in monoliths and tumuli, now used at the La Manche site. 9 references, 5 figures.

5442 (CONF-860990—Summ., pp 17-22) **Overview of EPA's low-level radioactive waste standards development program, 1986.** Galpin, F.L.; Meyer, G.L. (Environmental Protection Agency). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The EPA program to develop a Low-Level Radioactive Waste Standard has completed its risk assessment and cost-effectiveness analysis. The staff has structured the form of a standard which it plans to review with the Agency management. Consideration of elements to be contained in the standard include: (1) exposure limits for predisposal operations, (2) criteria for wastes that are Below Regulatory Concern, (3) post disposal exposure limits, and (4) ground water contamination limits. The rationale for these various elements of the Standard are explained and comments are solicited.

5443 (CONF-860990—Summ., pp 23-27) **DOE operational perspective.** Dieckhoner, J.E. (Environmental Protection Energy, Washington, DC). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The predominant problems facing the DOE in LLW management are implementing the Resource Conservation and Recovery Act for the mixed waste and the increasing involvement of the states that host DOE facilities. The paper discusses the RCRA jurisdictional issues, the RCRA technical issues, and the pursuit of technically sound and cost-effective improvements in management of "pure" low-level radioactive wastes by DOE.

5444 (CONF-860990—Summ., pp 31-36) **Challenges: a state and compact perspective.** Brown, H. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The challenges facing states and compacts in their efforts to implement the Low-Level Waste Policy Amendments Act are described. Institutional challenges include: small-volume sites; compact maintenance; shifting agencies and changing personnel; and timing of progress. The technical challenge lies in the enormous number of plans, procedures, and regulations that have to be developed over the next four years. There are two main fiscal challenges: funding of day-to-day operations of compact commissions; and financing the siting and construction of new disposal sites. There are also two main regulatory challenges: host states must develop regulations for siting and selection of technology; and all states have to await federal regulations to be completed. The final challenge is political: whether a region can overcome public opposition and actually site a facility.

5445 (CONF-860990—Summ., pp 37-45) **NRC low-level waste management goals: 1987-1993.** Starmer, R.J. (Nuclear Regulatory Commission). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The goal for the NRC low-level waste management program for the period 1987-1993 is based on NRC's mission to protect public health and safety and on the mandate of Congress to help assure that the States have provided adequate disposal capacity, individually or through compacts, by the end of this period. The NRC is working to establish a stable waste management environment by the middle of the next decade. In order to achieve this goal, the NRC must provide the regulatory foundation on which the States can base their own licensing efforts. This includes the development of review procedures and guidance documents to promote efficient review of license applications as well as removing potential impediments to development of disposal facilities. Examples of NRC staff action areas include: documentation of license application requirements; production of review plans; development of a policy on below regulatory concern; rule making to define requirements for emergency access under the LLRWPAA; development of guidance on the requirements for licensing alternative disposal technologies; clarification of the regulatory environment for disposal of mixed waste; and definition of the requirements for disposal as contrasted with those for storage. This will be accomplished along with the day-to-day business of licensing, preparing the closure of existing sites, review of topical reports and other regulatory activities. 3 tables.

5446 (CONF-860990—Summ., pp 46-50) **Developing new low-level radioactive waste disposal capacity in the US: the Department of Energy's role.** Coleman, J.A. (Dept. of Energy, Washington, DC). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Department of Energy recognizes the importance of Federal assistance to States and regions in planning and developing new low-level radioactive waste facilities. To the extent allowed by resources made available to the authors, DOE plans to provide this assistance in the form of information and available expertise within the Department as well as workshops, conferences, and evaluation of potential technologies of interest to States and compact regions. DOE also intends to assist in decision processes by preparation of design and licensing studies. Specific areas in which the DOE can assist states and compacts are discussed.

5447 (CONF-860990—Summ., pp 51-53) **Summary of session of disposal technology.** Colombo, P. (Brookhaven National Lab., Upton, NY). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Consensus of opinion on disposal technology is discussed. Shallow land burial is better understood as a result of site selection criteria and past experience. Regulation 10 CFR Part 61 is also now clear. Current technology can be improved above regulatory criteria. Public confidence appears to be a primary consideration in the selection of a technology. Applicability of RCRA regulations to low-level waste facilities needs to be addressed. Concern was expressed regarding continuous monitoring and other operational procedures at various sites.

5448 (CONF-860990—Summ., pp 54-57) **Summary of session on site closure.** Blauvelt, R.K. (Mound Lab., Miamisburg, OH). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

After briefly reviewing the five presentations, needs and potential problems were identified. Two major needs are a demonstration of site closure technology and cost information on site closure. Potential problem areas identified are: monitoring in the unsaturated zone; planning for long-term maintenance of monitoring equipment; techniques for monitoring chemical migration and identifying nonradiological constituents; deciding on performance objectives; and validating models.

5449 (CONF-860990—Summ., pp 58-60) **Summary of session on low-level waste information: data and systems.** Hardin, C.M. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

This paper summarizes the data and systems technical session by listing five uses of low-level waste information, six major users identified during the session, and four types of required data which must be obtained consistently. The types of data required are: characterization of the waste stream; category of the generator; waste treatment method; and on-site and off-site waste management practices. Two major points were emphasized. 1. There is a need for a centralized national registry for low-level waste data. 2. There is a need for cooperation within the low-level waste community to obtain the necessary data.

5450 (CONF-860990—Summ., pp 61-62) **Summary of session on waste treatment.** Pechin, W.H. (Oak Ridge National Lab., TN). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The session had three papers that dealt with specific waste treatment technologies, a paper that addressed a systems study on waste treatment, and a paper describing a new radioactive waste treatment system at West Valley, New York. Comments were made on the fewer number of papers on waste treatment this year than in past years. It was felt that many of the technologies have been developed and are in operation or ready for demonstration. Capital costs for demonstrations are a major constraint. Evaluation of a treatment was judged to be specific to application and site.

5451 (CONF-860990—Summ., pp 63-66) **Summary of session on performance assessment.** King, C.M. (Savannah River Lab., Aiken, SC). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Three major components of performance assessment are dealt with in the papers presented during this session. Facility assessment is the need to have a complete accurate understanding of the site and the nature of what went to the site, such as curie content and chemical composition. Exposure assessment is pathway analysis with model validation. Performance characterization finally generates data useful to decision makers. Also discussed briefly in this summary is the level of confidence one can give a performance assessment.

5452 (CONF-860990—Summ., pp 67-70) **Summary of session on state and regional progress toward disposal capacity.** Helminksi, E.L. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Two different areas were covered within the state and compact sessions: public participation and progress toward site development. Local control of a waste facility appears to be the best incentive for siting cooperation from the public. The progress in site development in each region is summarized. Economics of waste disposal were also discussed. Opinion seems to be that the public is not worried about cost; they want safety first. Waste generators, however, are concerned about cost.

5453 (CONF-860990—Summ., pp 71-73) **Summary of session on waste characterization and regulation.** Dressen, A.L. (Envirosphere Co.). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Four wastes were discussed: below regulatory concern, BRC, wastes; mixed wastes, i.e., low-level radioactive wastes and hazardous chemicals; naturally-occurring and accelerator-produced radioactive material, NARM; and carbon 14. A characterization and the regulatory issues involved with each waste are briefly summarized.

5454 (CONF-860990—Summ., pp 74-78) **Summary of session on future DOE low-level waste management.** Mezga, L.J. (Martin Marietta Energy Systems, Inc.). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012441/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The objectives of the session were to try to identify some of the major issues and factors which will likely impact the way the DOE manages the wastes it generates and disposes of at its facilities. Session papers then tried to discuss an approach that DOE is looking at to address these concerns. And finally the session took a look at two sites to see how they are addressing some of these changes and factors. Papers presented at the session are summarized. The major issues and conclusions that resulted from this session involve three areas: potential implications of RCRA on LLW management; a systems approach to the design of a LLW management system; and the development of an integrated system. Each of these are discussed.

5455 **(CONF-871075—2) Oak Ridge greater confinement disposal demonstrations.** Van Hoesen, S.D.; Clapp, R.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000583/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Demonstrations are being conducted in association with the disposal of a high activity low-level waste (LLW) stream. The waste stream in question will result from the cement solidification of decanted liquids from the Melton Valley Storage Tanks (MVST). The solid waste will be produced beginning in mid summer 1988. It is anticipated to have significant concentrations of Cs-137 and Sr-90, with smaller amounts of other radionuclides and <100 nCi/gm of TRU. The solid waste forms are expected to have surface dose rates in the 1 to 2 r/hr range. The solid waste will also contain several chemical species at concentrations which are below those of concern, but which may present enhanced corrosion potential for the disposal units. 2 refs., 5 figs.

5456 **(CONF-871075—7) In situ grouting of buried transuranic waste with polyacrylamide.** Spalding, B.P.; Lee, S.Y.; Farmer, C.D.; Hyder, L.K.; Supaokit, P. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000545/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

This project is a demonstration and evaluation of the in situ hydrologic stabilization of buried transuranic waste at a humid site via grout injection. Two small trenches, containing buried transuranic waste, were filled with 34.000 L of polyacrylamide grout. Initial field results have indicated that voids within the trenches were totally filled by the grout and that the intratrench hydraulic conductivity was reduced to below field-measurable values. No evidence of grout constituents were observed in twelve perimeter groundwater monitoring wells indicating that grout was contained completely within the two trenches. Polyacrylamide grout was selected for field demonstration over the polyacrylate grout due to its superior performance in laboratory degradation studies. Also supporting the selection of polyacrylamide was the difficulty in controlling the set time of the acrylate polymerization. Based on preliminary degradation monitoring, the polyacrylamide was estimated to have a microbiological half-life of 362 years in the test soil. 15 refs., 9 figs., 12 tabs.

5457 **(CONF-871075—11-Vugraphs) Computer modeling of greater confinement disposal of radioactive waste at the Nevada Test Site.** Ebeling, L.L. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Oct 1987. Contract AC08-84NV10327. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000955/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A 1.1 MegaCuri and 3.5 kilowatt waste source has been buried 30 meters down an auger hole in a tuffaceous alluvium for over three years. Temperature and moisture have been monitored in the surrounding soil during this time and two gaseous tracer migration studies conducted to determine flow parameters. Temperatures exceeding 300°C have been recorded and the moisture range has increased from 10 to 12% to 2 to 14%. The tracer migration data is being analyzed. A two-dimensional transient multi-phase and E.P.A. accepted model, WAFE, is being used to simulate this data and make long term performance projections. Many problems associated with precession, array boundaries and local subroutines have been encountered in converting the model which was developed on the Los Alamos National Laboratory's CRAY based computer system to run on a DEC/VAX 750. Documentation, which is still in rough draft, has also made the valid modification of the code or organization of an input data file difficult. 10 figs.

5458 **(CONF-871075—12) In situ vitrification demonstration for the stabilization of buried wastes at the Oak Ridge National Laboratory.** Jacobs, G.K.; Spalding, B.P.; Carter, J.G.; Koegler, S.S. (Oak Ridge National Lab., TN (USA); Pacific Northwest Lab., Richland, WA (USA)). 1987. Contract AC06-76RL01830;AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001418/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A demonstration of In Situ Vitrification (ISV) technology for the stabilization of radioactively contaminated soil sites at the Oak Ridge National Laboratory (ORNL) was successfully completed during July 1987. This demonstration is the first application of the ISV process not performed at the Hanford Site, where the technology was developed. The joint ORNL-PNL pilot-scale demonstration was performed on a 3/8-scale trench (2 m deep x 1 m wide x 10 m long) that was constructed to simulate a typical seepage trench used for liquid low-level radioactive waste disposal at ORNL from 1951 to 1966. In the ISV process, electrodes are inserted around a volume of contaminated soil, power is applied to the electrodes, and the entire mass is melted from the surface of the soil down through the contaminated zone, thus making a glassy-to-microcrystalline waste form that incorporates the contaminants. Gases produced during the melting are collected, treated, monitored, and released through an off-gas process trailer. In the ORNL demonstration, a 25-t mass of melted rock approximately 1.2 m thick x 2.1 m wide x 4.9 m long was formed during 110 h of operation that consumed approximately 29 MWh of power. Data obtained on the operational performance of the test and waste-form durability will be used to assess the feasibility of applying the ISV technology to an actual waste trench.

5459 **(CONF-871075—14) Charging generators for waste management costs.** Berry, J.B.; Homan, F.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001433/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

DOE-Oak Ridge Operations (DOE-ORO) has recognized that an effective waste management program focuses on control at the source and that the burden for responsible waste management can be placed on generators by charging for waste management costs. The principle of including the waste management costs in the total cost of the product, even when the product is research and development, is being implemented at Oak Ridge National Laboratory (ORNL). Charging waste management costs to the pollutor creates an incentive to optimize processes so that less waste is produced and provides a basis for determining the cost effectiveness. 2 refs., 1 fig., 1 tab.

5460 **(CONF-871075—20) RCRA [Resource Conservation and Recovery Act] waste oversight: Lead.** Alexander, W.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001746/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Historically, in the nuclear industry, water, concrete, steel, and lead have been common materials used for radiation shielding purposes. Lead, a high-density material, is a very effective shield for gamma radiation and has been utilized extensively at the Oak Ridge National Laboratory (ORNL) in association with radioisotope production and nuclear research. During these activities, lead became an inherent part of the radioactive waste and was disposed of in massive quantities by land burial.

5461 **(CONF-8709170—1) Closure of the Oak Ridge National Laboratory Hydrofracture Facility: An opportunity to study the fate of radioactive wastes disposed of by subsurface injection.** Haase, C.S.; Von Damm, K.L.; Stow, S.H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001738/JAW.

From International symposium on class V injection well technology; Washington, DC, USA (22 Sep 1987).

At Oak Ridge National Laboratory, subsurface injection has been used to dispose of liquid low-level nuclear waste for the past two decades. The process consists of mixing the liquid waste with cement and other additives to form a slurry that is injected under pressure through a cased well into a low-permeability shale at a depth of approximately 300 m (1000 ft). The slurry spreads from the well along hydraulic fractures and sets to form irregularly shaped grout sheets of up to 200 m (650 ft) in radius. Closure-related site characterization provides a unique opportunity to study the fate of the injected wastes. A series of monitoring wells are in place to measure groundwater chemistries within the injection strata and within overlying and underlying confining units. Initial results indicate that contaminated groundwater surrounds the grout sheets in the injection zone, extending at least as far as 300 m (1000 ft) from the injection well; contaminated groundwater is largely and perhaps exclusively confined to the host formation; and of the ^{90}Sr and ^{137}Cs radionuclides disposed of, only ^{90}Sr is present in the contaminated groundwater. The illite-rich mineralogy of the injection formation strongly absorbs ^{137}Cs and greatly retards its migration. Movement of ^{90}Sr is not as greatly retarded by the injection formation. Geochemical modeling is being used to identify and to evaluate hydrogeological controls on ^{90}Sr behavior. Preliminary results suggest that the groundwaters within the injection formation are saturated with Sr from natural sources, and that ^{90}Sr mobility may be lessened by precipitation/dissolution reactions associated with such a saturated condition. 27 refs., 4 figs., 2 tabs.

5462 (CONF-8710184—3) **Implications of new regulations dealing with hazardous materials.** Moreland, W.M.; White, D.A.; Wells, S.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001751/JAW.

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

Various laws and regulations dealing with hazardous/radioactive materials must be followed in developing and implementing adequate training programs for DOE facilities to comply with the Resource Conservation and Recovery Act (RCRA), the Superfund Amendments and Reauthorization Act (SARA), Hazard Communication (HAZCOM), substance-specific regulations, and Department of Transportation (DOT) regulations. These laws and regulations require training for all individuals working with hazardous/radioactive materials. Facilities that are involved in the generation, storage, treatment, transportation, or disposal/removal of hazardous materials/waste must comply with all relevant training regulations. Using the guidelines contained in EPA, OSHA, DOT, and DOE regulations, decisions must be made to determine: if regulatory compliance is required based on facility function; the type of training required for specific categories of workers; and the level of training needed for each category of worker. This report outlines how the Environmental Compliance and Health Protection Technical Resources and Training Program, working with other ORNL groups in environmental compliance, health protection, and waste operations, establishes specific training requirements to comply with pertinent EPA, OSHA, DOT, and DOE regulations. 3 tabs.

5463 (DOE/AL/10752—34) **The Rustler Formation at the WIPP [Waste Isolations Pilot Plant] site: Report of a workshop on the geology and hydrology of the Rustler Formation as it relates to the WIPP Project.** Chaturvedi, L. (ed.). (New Mexico Health and Environment Dept., Santa Fe (USA). Environmental Evaluation Group). Feb 1987. Contract AC04-78AL10752. 80p. (EEG—34). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87010503/JAW.

This workshop contained eight papers characterizing the Rustler Formation at the WIPP site in New Mexico. Four of these reports were processed separately for the data bases. Information contained in the four remaining papers is available in journal articles or in the reports of other conferences and included discussions of ground water flow through the Rustler Formation, the potential migration of leached radionuclides in this rock, the effects of mineral dissolution on the removal of underlying salt deposits, and a possible pathway for radionuclide migration into the biosphere. (TEM)

5464 (DOE/AL/10752—34, pp 16-25) **Stratigraphy and dissolution of the Rustler Formation.** Bachman, G.O. (Sandia National Labs., Albuquerque, NM). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87010503/JAW.

In The Rustler Formation at the WIPP site: Report of a workshop on the geology and hydrology of the Rustler Formation as it relates to the WIPP Project.

This report describes the physical stratigraphy of the Rustler Formation, because the Waste Isolation Pilot Plant will be constructed in salt beds that underlie this formation. Described are subdivisions of the formations, the major karst features, and a proposed method for the formation of Nash Draw. 2 refs., 2 figs. (TEM)

5465 (DOE/AL/10752—34, pp 26-35) **Rustler Formation in the waste handling and exhaust shafts, Waste Isolation Pilot Plant (WIPP) site, southeastern New Mexico.** Holt, R.M.; Powers, D.W. (IT Corp., Albuquerque, NM). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87010503/JAW. Contract AC04-78AL05346.

In The Rustler Formation at the WIPP site: Report of a workshop on the geology and hydrology of the Rustler Formation as it relates to the WIPP Project.

The Permian Rustler Formation was recently examined in detail in two shafts at the WIPP site: the waste handling shaft (waste shaft) and the exhaust shaft. Fresh exposures of the Rustler in the shafts exhibited abundant primary sedimentary structures. The abundance of primary sedimentary structures observed in the shafts is unequaled in previously described sections. Data are reported here in their stratigraphic context as an initial basis for evaluation of depositional environments of the Rustler and reevaluating the role of dissolution in the formation of the Rustler. 10 refs.

5466 (DOE/AL/10752—34, pp 36-57) **Stable-isotope studies of groundwaters in southeastern New Mexico.** Lambert, S.J. (Sandia National Labs., Albuquerque, NM). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87010503/JAW. Contract AC04-76DP00789.

In The Rustler Formation at the WIPP site: Report of a workshop on the geology and hydrology of the Rustler Formation as it relates to the WIPP Project.

Oxygen-18/16 and deuterium/hydrogen ratio measurements have been made on groundwaters sampled according to specific field criteria applied during pump tests of the Rustler Formation in Nash Draw, a solution-subsidence valley west of the WIPP site in the northern Delaware Basin of southeastern New Mexico. Comparison of these data with similar measurements on other groundwaters from the northern Delaware Basin indicates two nonoverlapping populations of meteoric groundwaters. Most of the Rustler waters in Nash Draw and at the WIPP site and older waters from the eastern two-thirds of the Capitan Limestone constitute one population, while unconfined groundwaters originating as observable modern surface recharge to alluvium, the near-surface Rustler in southwestern Nash Draw, and the Capitan in the Guadalupe Mountains (Carlsbad Caverns) constitute the other. The isotopic distinction suggests that Rustler groundwater in most of Nash Draw and at the WIPP site is not receiving significant modern meteoric recharge. A likely explanation for this distinction is that meteoric recharge to most of the Rustler and Capitan took place in the geologic past under climatic conditions significantly different from the present. 25 refs., 4 figs., 2 tabs.

5467 (DOE/AL/10752—34, pp 58-70) **A regional water balance for the WIPP site and surrounding area.** Hunter, R.L. (Sandia National Labs., Albuquerque, NM). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87010503/JAW.

In The Rustler Formation at the WIPP site: Report of a workshop on the geology and hydrology of the Rustler Formation as it relates to the WIPP Project.

A water balance or budget is developed as an accounting of the components of a closed hydrologic system. In the WIPP study area, water-budget techniques have previously been used to compute leakage from Lake Avalon and from potash refinery spoil ponds. A general expression for a closed hydrologic system is presented. In a developed area like the WIPP region, the water budget must include many usage factors, such as municipal or industrial

pumpage. In the WIPP water-budget study area, inflows are precipitation, surface- and ground-water inflow, and the artificial addition of surface and ground water. Outflows are surface runoff, evaporation and transpiration, and ground-water outflow. Changes in storage in the WIPP region have also been documented. The WIPP water balance described here is based on a combination of long-term averages and figures for 1980. 12 refs., 5 figs., 1 tab.

5468 **(DOE/EA—0332) Environmental assessment of remedial action at the Mexican Hat uranium mill tailings site, Mexican Hat, Utah.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Oct 1987. 275p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88001916/JAW.

This document assesses the environmental impacts of the proposed remedial action at the Mexican Hat uranium mill tailings site located on the Navajo Reservation in southern Utah. The site covers 235 acres and contains 69 acres of tailings and several of the original mill structures. Remedial action must be performed in accordance with standards and with the concurrence of the US Nuclear Regulatory Commission and the Navajo Nation. The proposed action is to stabilize the tailings within the present tailings site by consolidating the tailings and associated contaminated soils into a recontoured pile. A radon barrier of compacted earth would be constructed over the pile, and various erosion control measures would be taken to assure the long-term stability of the pile. The no action alternative is also assessed in this document. 240 refs., 12 figs., 20 tabs.

5469 **(DOE/ID—10086(86)) Solid Waste Information Management System (SWIMS) data summary, calendar year 1986.** Watanabe, T. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1987. Contract AC07-76ID01570. 231p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88002207/JAW.

The Solid Waste Information Management System (SWIMS) is a Department of Energy information system for radioactive solid waste. This document is a summary of the CY 1986 data and the forecasted data for CY 1987 reported by DOE sites. Detailed data are included in the appendices.

5470 **(DOE/ID—10090(86)) Radioactive solid waste inventories at United States Department of Energy burial and storage sites.** Watanabe, T. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1987. Contract AC07-76ID01570. 85p. NTIS, PC A05. Order Number DE88001597/JAW.

Radioactive solid waste inventories are given for United States Department of Energy (DOE) burial and storage sites. These data are obtained from the Solid Waste Information Management System (SWIMS) and reflect the inventories as of the end of the calendar year 1986. 4 figs., 7 tabs.

5471 **(DOE/ID/12497—1) User's manual for applicants proposing on-site burial of self-generated radioactive waste.** Tolbert, M.E.M.; Loretan, P.A. (Tuskegee Inst., AL (USA). Carver Research Foundation). [1987]. Contract FG07-84ID12497. 51p. NTIS, PC A04. Order Number DE88001577/JAW.

This document describes, for medical and research institutions as well as industrial generators of low-level radioactive waste, the NRC or state submittal requirements for authorizing the on-site burial of self-generated radioactive waste. An important part of completing the license application for operation justifying this alternative for waste disposal over other alternatives. Reasons that might be considered acceptable might include the need to dispose of large volumes of low activity waste that would otherwise take up valuable space in commercial sites; the ability to demonstrate that this method of disposal will result in reduced exposures to the public; the ability to show that the prohibitive costs of other methods of disposal would be detrimental to the progress of significant research which generates radioactive waste. 19 refs., 3 figs., 4 tabs.

5472 **(DOE/OR/21495—T2) Numerical computations of natural convection heat transfer in irregular geometries: [Final technical report].** Glakpe, E.K. (Howard Univ., Washington, DC (USA)). 23 Jan 1987. Contract FG05-84OR21495. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002358/JAW.

This report explains the determination of buoyancy driven flow characteristics and heat transfer in enclosures of complex geometrical shapes. Applications of buoyancy driven flows can be found in solar collector devices, energy conservation technologies, cooling of micro-electronic chips, and nuclear reactor spent fuel shipping configurations. The problem is further complicated when three dimensional effects, non-Boussineaq effects, turbulence, and heat transfer by radiation are accounted for in the overall balance of energy transfer. This study developed a capability to model and predict the heat transfer and flow characteristics in shipping cask configurations involving light water and fast reactor fuel assemblies. We explored the complex flow phenomena involved in these configurations to develop numerical prediction capabilities to obtain data for the design and/or thermal analysis of such shipping casks.

5473 **(DOE/RW—0006-Rev.3) Integrated data base for 1987: Spent fuel and radioactive waste inventories, projections, and characteristics.** (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 286p. (ORNL/M—421). Office of Civilian Radioactive Waste Management, Washington, DC 20585. Order Number TI88001700/JAW.

The Integrated Data Base (IDB) Program has compiled current data on inventories and characteristics of commercial spent fuel and both commercial and US government-owned radioactive wastes through December 31, 1986. These data are based on the most reliable information available from government sources, the open literature, technical reports, and direct contacts. Current projections of future waste and spent fuel to be generated through the year 2020 and characteristics of these materials are also presented. The information forecasted is consistent with the latest US Department of Energy/Energy Information Administration projections of US commercial nuclear power growth and the expected defense-related and private industrial and institutional activities. The radioactive materials considered, on a chapter-by-chapter basis, are spent fuel, high-level waste, transuranic waste, low-level waste, commercial uranium mill tailings, remedial action waste, and decommissioning waste. For each category, current and projected inventories are given through the year 2020, and the radioactivity and thermal power are calculated based on reported or estimated isotopic compositions. In addition, characteristics and current inventories are reported for miscellaneous, highly radioactive materials that may require geologic disposal. 82 refs., 57 figs., 121 tabs.

5474 **(DOE/SR/14037—1) Independent assessment of the overall Defense Waste Processing Facility Project: Semiannual report, May 1987.** Aupperle, K.J. (Stone and Webster Engineering Corp., Boston, MA (USA)). 31 May 1987. Contract AC09-86SR14037. 221p. NTIS, PC A10/MF A01; GPO Dep. Order Number DE88000798/JAW.

This report provides an overall review of selected aspects of the Defense Waste Processing Facility (DWPF) program and a summary of the review and conclusions is provided. Specific analysis and conclusions relative to the review of prior A.D. Little Report findings, technology development, project controls, materials management, as-built drawing program, quality assurance for waste acceptance, and the testing and start-up program are provided in Sections 2 through 8. 25 figs., 4 tabs.

5475 **(DOE/WIPP—87-008) Brine Sampling and Evaluation Program: Phase 1 report.** Deal, D.E.; Case, J.B. (Westinghouse Electric Corp., Carlsbad, NM (USA). Engineering and Repository Technology Dept.). 15 Jun 1987. Contract AC04-86AL31950. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88000631/JAW.

This interim report presents preliminary data obtained in the course of the WIPP Brine Sampling and Evaluation Program. The investigations focus on the brine present in the near-field environment around the WIPP underground workings. Although the

WIPP underground workings are considered dry, small amounts of brine are present. This amount of brine is not unexpected in rocks of marine sedimentary origin. Part of that brine can and does migrate into the repository in response to pressure gradients, at essentially isothermal conditions. These small volumes of brine have little effect on the day-to-day operations, but are pervasive throughout the repository and may contribute enough moisture over a period of years to affect resaturation and repressurization after sealing and closure. Gas bubbles are observed in many of the brine occurrences. Gas is also known to exsolve from solution as the brine is poured from container to container. 68 refs., 9 figs., 2 tabs.

5476 **(DPST—85-699) Road A Chemical Basin: Environmental information document.** Pickett, J.B.; Muska, C.F.; Bledsoe, H.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000757/JAW.

The Road A Chemical Basin at the Savannah River Plant was closed and backfilled in 1973. It received miscellaneous radioactive and chemical aqueous waste. Four groundwater monitoring wells indicate no elevated levels of analytes in the groundwater. The closure options considered for this waste site are waste removal and closure, no waste removal and closure, and no action. Modeling calculations were made to determine the risks to human population for the three postulated closure options. An ecological assessment was conducted to predict the environmental impacts on aquatic and terrestrial biota. The relative costs for each of the closure options were estimated. Maximum health risk due to radioactive materials (^{238}U) is about 8.0E-06 excess health effects per year, for the no action option. The no waste removal and closure and waste removal and closure options reduce the calculated risk to about 1.2E-06 and 1.2E-08 HE/yr, respectively. The maximum calculated impact due to noncarcinogenic materials (lead) is 0.54 ADI fraction. The maximum calculated ADI fraction for lead after the period of institutional control is 4.1 E-04 for the reclaimed-farmland pathway for the no action option. Public risk attributable to atmospheric releases of chemical and radioactive constituents is minimal. For all years and options modeled, the noncarcinogenic risks calculated were zero except for the year of excavation, which had an ADI fraction of 1.41E-09. The maximum individual radiological health risk for the waste removal and closure option is small (6.97E-12 HE/yr). The radiological health effects for the no waste removal and closure and no action options are zero. The ecological assessment shows that the effects of any closure activities on river water quality and wildlife would be insignificant. The cost estimates show that the waste removal and closure option is the most expensive ($4,000,000). 41 refs., 13 figs., 41 tabs.

5477 **(DPST—85-893) 1985 monitoring report for the defense waste lysimeters.** Oblath, S.B.; Grant, M.W. (Savannah River Lab., Aiken, SC (USA)). 4 Nov 1985. Contract AC09-76SR00001. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001376/JAW.

Isotopic radionuclide analysis of the effluents from the forty defense waste lysimeters continued over the past year. The discussion is limited to the measurements of the past year only. Cesium-137 was the only additional isotope observed. Pu-238, Pu-239, Am-241, Sr-90, Co-60, Ru-106, and Sb-125 continue to be observed. Mn-54 was no longer detected. Concentrations were generally the same or lower for all of the isotopes, with the exception of Sr-90. Significant increases in Sr-90 levels were observed from 8 of 25 lysimeters. The maximum activity level observed was 1420 pCi/L of Sr-90 from a High Level Caves waste lysimeter. Fractional release rates for each isotope are reported as the maximum observed values. Speciation studies showed that the cobalt which has been released from the lysimeters is generally anionic. Only one lysimeter released sufficient quantities of Co-60 to perform this measurement. Ru-106 and Sb-125 had been shown previously to be anionic in the lysimeter effluent. Pine trees continues to grow well on four of the lysimeters. The trees have reached sufficient size that all of the water entering the lysimeter is being lost by evapotranspiration and effluent water was no longer available for sampling. Vegetative uptake must be the predominant pathway for migration in these lysimeters since there in no longer any release via the water. 5 refs., 1 fig. 1 tab.

5478 **(EGG-M—12187) Field testing of waste forms using lysimeters.** Rogers, R.D.; McConnell, J.W.; Davis, E.C.; Findlay, M.W. (EG and G Idaho, Inc., Idaho Falls (USA); Argonne National Lab., IL (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC07-76ID01570. 17p. (CONF-870511—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001501/JAW.

From 4. international hazardous waste symposium on environmental aspects of stabilization-solidification of hazardous and radioactive wastes; Atlanta, GA, USA (3 May 1987).

This paper describes field testing and gives preliminary findings. Solidified ion exchange resin materials from EPICOR-II prefilters used in the cleanup of the Three Mile Island Nuclear Power Station are being field tested to develop a low-level waste data base and obtain information on survivability of waste forms composed of ion exchange media loaded with radionuclides and solidified in martices of cement and Dow polymer. Emphasis is placed on obtaining data on performance of waste in a disposal environment using lysimeter arrays at Oak Ridge National Laboratory and Argonne National Laboratory in Illinois. 6 refs., 9 figs., 5 tabs.

5479 **(ENEA-RT-PAS—86-16) Erosion and safety of the underground disposal of radioactive wastes.** Grauso, S.; Polizzano, C. (ENEA, Casaccia, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1986. 19p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700760/JAW.

In this report the problem concerning the evaluation of long-term geomorphic stability is discussed, with regard to the influence of possible morphologic modification of topographic surface on the containment of radioactive wastes in deep geological formations. A research program concerning the individuation of evolutive models is illustrated, on the basis of the understanding of present and past erosive processes and vertical mobility.

5480 **(EUR—10675) Application of inorganic ion exchangers for low and medium activity radioactive effluent decontamination.** Dozol, J.F.; Eymard, S.; Gambade, R.; La Rosa, G. (Commission of the European Communities, Luxembourg). 1986. 186p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750626/JAW.

This study proposes an alternative pretreatment or treatment for low and medium activity liquid wastes, allowing to improve the quality of containment and decrease the cost of storage. Inorganic ion exchangers are used to remove alpha emitters and long lived fission products and concentrate them in a small volume; these exchangers can be converted into a stable matrix by thermal treatment. This treatment, at least for some liquid wastes, don't exclude a complementary decontamination by chemical precipitation. Sludges, arising from precipitation, exempt from alpha emitters and long lived fission products can be stored in a shallow land burial. This study includes two parts: Measurements of distribution coefficients for the main nuclides in order to choose, for each liquid wastes, the most suitable ion exchanger. Estimation of performances of selected inorganic ion exchangers, from tests of percolation of genuine effluents.

5481 **(EUR—10822) Active liquid treatment by a combination of precipitation and membrane processes.** Gutman, R.G.; Cumming, I.W.; Williams, G.H. (Commission of the European Communities, Luxembourg). 1986. 206p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750625/JAW.

Ultrafiltration-based processes have been developed for the treatment of low and medium-active radioactive wastes. Actinides such as U, Pu and Am were found to be present as insoluble species in many effluents and were separated with high efficiency, by direct ultrafiltration. Soluble nuclides, including complexed actinides, Sr and Cs, were removed at > 99 % efficiency by combined processes, in which very low concentrations (< 10 g/m/sup 3/) of ultrafine activity absorbing precipitates were added. The new ultrafiltration processes were applied successfully to a variety of simulated and real wastes, including magnesium alloy clad spent storage fuel pond waters, reprocessing plant solvent wash liquors, plutonium production effluents and mixed site effluents. After initial labo-

ratory scale feasibility experiments, the process was scaled up, using a variety of different ultrafiltration modules. An inorganic, tubular ultrafiltration module was selected for more detailed investigation and an automated mini-unit was constructed for longterm evaluation. The information thus accumulated on membrane performance, membrane fouling and flux restoration techniques, and ancillary equipment performance was used to design a much larger demonstration pilot plant. This plant is now processing continuously each day over 1 m/sup 3/ of a real radioactive effluent.

5482 **(EUR—10847-Vol.2) Characterization of candidate buffer materials: Volume 2, Thermo-mechanical calculation of the buffer in crystalline rock environment: Final report.** Broc, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development). 1987. 148p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88900104/JAW.

This study concerns repositories in hard rock (granite). Volume 2 covers a preliminary thermo-mechanical calculation of the canister-buffer-host rock complex in a crystalline rock environment.

5483 **(FMPC—2096) The waste minimization program at the Feed Materials Production Center.** Blasdel, J.E.; Crotzer, M.E.; Gardner, R.L.; Kato, T.R.; Spradlin, C.N. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 1987. Contract AC05-86OR21600. 16p. (CONF-870859—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001609/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A waste minimization program is being implemented at the Feed Materials Production Center to reduce the generation of uranium-contaminated wastes and to comply with existing and forthcoming regulations. Procedures and plans are described which deal with contaminated wood and metals, used metal drums, and major process wastes such as contaminated magnesium fluoride and neutralized raffinate. Waste minimization techniques used include segregation, source reduction, volume reduction, material substitution and waste/product recycle. The importance of training, communication, and incentives is also covered. 5 refs., 11 figs.

5484 **(FRCEA-R—17) Characterization of low and medium level radioactive wastes.** Nomine, J.C.; Tassigny, C. de; Billon, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Nov 1983. 81p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750641/JAW.

Leaching tests on real wastes embedded in cement, bitumens or resins are realized to study leachability of alpha-emitters or fission products and anion-cation exchange between leachate and embedded materials. Radionuclide distribution is examined by spectrogammametry on cores taken from cemented wastes. Qualitative results concerning degradation of waste blocks embedded in bitumens by bacteria in the ground are given.

5485 **(GAO/RCED—86-4) Nuclear waste: Department of Energy's program for financial assistance.** (General Accounting Office, Washington, DC (USA)). 1986. 50p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of Energy's existing grant guidelines for financial assistance to first and second repository states do not clearly establish a basis for determining who is funded, what activities are funded, and how much funding is provided each activity. Because the guidelines do not cover all funding circumstances, DOE has interpreted them differently when making both mandatory and discretionary grant decisions. In addition, DOE has not considered state and Indian tribe needs in establishing its budget request for grant awards. Instead, the requests are based on the amounts of grants awarded in prior years and DOE planned activities. Finally, both grantee compliance with certain reporting requirements of DOE's financial assistance regulations and DOE's enforcement of them has been inconsistent.

5486 **(GAO/RCED—86-90) Nuclear waste: Department of Energy's Transuranic Waste Disposal Plan needs revision.** (General Accounting Office, Washington, DC (USA)). 1986. 36p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Transuranic waste consists of discarded tools, rags, machinery, paper, sheet metal, and glass containing man-made radioactive elements that can be dangerous if inhaled, ingested, or absorbed into the body through an open wound. GAO found that the Defense Waste Management Plan does not provide the Congress with complete inventory and cost data or details on environmental and safety issues related to the permanent disposal of TRU waste; the Plan's $2.8 billion costs are understated by at least $300 million. Further, it does not include costs for disposing of buried waste, contaminated soil, and TRU waste that may not be accepted at the Waste Isolation Pilot Plant. Lastly, the Plan provides no details on the environmental and safety issues related to the permanent disposal of TRU waste, nor does it discuss the types of or timing for environmental analyses needed before WIPP starts operating.

5487 **(GAO/RCED—86-104FS) Nuclear waste: Monitored retrievable storage of spent nuclear fuel.** (General Accounting Office, Washington, DC (USA)). 1986. 32p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The primary purpose of a monitored retrievable storage facility would be to receive and prepare spent nuclear fuel from commercial reactors for disposal in a geologic repository. The Department of Energy has concluded that an MRS facility located in Tennessee would significantly improve the performance of the nuclear waste management system and has identified three sites that it considered the most favorable-the cancelled Clinch River Breeder Reactor Project site, a site on Oak Ridge Reservation, and the site of the Tennessee Valley Authority's cancelled nuclear power plant. This fact sheet described Tennessee's role in the development of the MRS, potential advantages and disadvantages of MRS, and state and local impacts of siting an MRS facility in Tennessee.

5488 **(GAO/RCED—86-154FS) Nuclear waste: Quarterly report on DOE's Nuclear Waste Program as of March 31, 1986.** (General Accounting Office, Washington, DC (USA)). 1986. 21p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

This fact sheet shows that the methodology the Department of Energy used to evaluate and rank the first repository sites for nuclear waste is satisfactory and appropriate. It also shows that DOE complete its proposal for a monitored retrievable storage facility but that a U.S. district court ruled that DOE could not submit the proposal to the Congress; that DOE issues a report identifying 12 areas in 7 states as proposed potentially acceptable sites for a second waste repository; and that the Nuclear Waste Fund balance is about $1.6 billion.

5489 **(GAO/RCED—86-192) Nuclear energy: Environmental issues at DOE's nuclear defense facilities.** (General Accounting Office, Washington, DC (USA)). 1986. 49p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

GAO's review of nine Department of Energy defense facilities identified a number of significant environmental issues: (1) eight facilities have groundwater contaminated with radioactive and/or hazardous substances to high levels; (2) six facilities have soil contamination in unexpected areas, including offsite locations; (3) four facilities are not in full compliance with the Clean Water Act; and (4) all nine facilities are significantly changing their waste disposal practices to obtain a permit under the Resource Conservation and Recovery Act. GAO is recommending that DOE develop and overall groundwater and soil protection strategy that would provide a better perspective on the environmental risks and impacts associated with operating DOE's nuclear defense facilities. GAO also recommends that DOE allow outside independent inspections of

the disposal practices used for any waste DOE self-regulates and revise its order governing the management of hazardous and mixed waste.

5490 **(GAO/RCED—86-198FS) Nuclear waste: Cost of DOE's proposed monitored retrievable storage facility.** (General Accounting Office, Washington, DC (USA)). 1986. 21p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of Energy has developed a proposal for including a monitored retrievable storage facility in the system for managing commercial and defence-related nuclear wastes. As the basis for its cost estimates DOE used sealed, aboveground storage casks at a facility to be located in Clinch River, Tennessee. Among the factors affecting the cost estimates are design and construction, not including land; and the cost of integrating the aboveground storage casks into the total waste management system to range from $1.4 billion to $2.0 billion and a revised range of between $1.6 billion and $2.6 billion.

5491 **(GAO/RCED—86-200FS) Nuclear waste: Issues concerning DOE's postponement of second repository siting activities.** (General Accounting Office, Washington, DC (USA)). 1986. 21p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

In May 1986 the Department of Energy announced it was postponing site-specific work for a second nuclear waste repository because of progress made in siting the first repository and the uncertainty about when a second repository might be needed. A DOE draft report, which tentatively identified potential sites in seven different states, received considerable comment and objections by concerned states, Indian tribes, and individuals. Following the postponement decision, DOE initiated actions to redirect and restructure the second repository program, concentrating on technical issues rather than site-specific work. This reduction includes a phase-down of siting activities and the formulation of a Technology Development Program with an emphasis on cooperative efforts in international research.

5492 **(GAO/RCED—87-14) Nuclear waste: Institutional relations under the Nuclear Waste Policy Act of 1982.** (General Accounting Office, Washington, DC (USA)). 1987. 60p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Nuclear Waste Policy Act of 1982 requires the Department of Energy to construct the nation's first permanent deep underground nuclear waste repository and stipulates that DOE is to consult and cooperate with states and Indian tribes to promote their confidence in the safety of the disposal program. States and Indian tribes are concerned about the potential environmental and socioeconomic impacts of siting a repository in their region and believe that DOE has not allowed them to participate in the program to the extent intended by the act. These views have led to lawsuits between DOE and the affected states and tribes. GAO believes that DOE can better involve states and tribes and thereby lessen their concerns about their amount of participation.

5493 **(GAO/RCED—87-30) Nuclear waste: Unresolved issues concerning Hanford's waste management practices.** (General Accounting Office, Washington, DC (USA)). 1987. 69p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of Energy's Hanford, Washington, facility has produced plutonium for nuclear weapons for more than 40 years. As a result, it generates radioactive, hazardous, and mixed waste. GAO found that Hanford has been slow to implement two waste management statutes. It disposes of liquid low-level waste directly to the soil - a practice that contributes to groundwater contamination. Hanford believes that the Atomic Energy Act exclusions allow them to dispose of byproduct waste in this manner without a permit; at the same time, Hanford has begun to apply for permits to dispose of similar, nonbyproduct waste. Further, Hanford does not meet groundwater monitoring requirements at four hazardous or mixed waste units; other units also may not comply.

5494 **(GAO/RCED—87-48FS) Nuclear waste: Quarterly report on DOE's nuclear waste program as of September 30, 1986.** (General Accounting Office, Washington, DC (USA)). 1987. 20p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

This fact sheet provides the status of the Department of Energy's nuclear waste program activities for the quarter ending September 1986. The activities include (1) the President's approval of potential first repository sites in Nevada, Texas, and Washington for detailed studies; (2) a DOE announcement of an indefinite postponement of any site-specific work on a second repository; (3) unresolved pending court cases concerning nuclear waste and nine new actions initiated against DOE; and (4) the collection of over $84.6 million in fees and investment income and obligations of about $144 million for program activities. The fund balance as of September 1986 was about $1.4 billion.

5495 **(GAO/RCED—87-73FS) Nuclear health and safety: DOE's progress in implementing its 1985 initiatives.** (General Accounting Office, Washington, DC (USA)). 1987. 12p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of Energy announced several initiatives to strengthen its environmental, safety, and health programs with progress in implementing all but one of the initiatives. Specifically, the reorganization of ES and H activities is essentially complete; DOE has revised six ES and H orders governing the conduct of DOE operations; and field work for DOE's environmental surveys has been completed at eight facilities with interim reports scheduled to be available early in 1987.

5496 **(GAO/RCED—87-95FS) Nuclear waste: Quarterly report on DOE's Nuclear Waste Program as of December 31, 1986.** (General Accounting Office, Washington, DC (USA)). 1987. 23p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Activities of the Department of Energy's nuclear waste program for the quarter ending December 1986 included (1) emphasis placed on preparing site characterization plans which will provide the basis for deciding on the preferred site for the nation's first nuclear waste repository; (2) the establishment of a Repository Technology and Transportation Division to manage responsibilities concerning high-level waste; (3) a ruling that DOE is not required to consult with any state before it submits the monitored retrievable storage proposal to the Congress; and (4) the collection of over $175.2 million in fees and investment income by the Nuclear Waste Fund and its obligation of about $171 million for program activities. In addition, DOE released the nuclear waste program's planning document amendment which extends for 5 years its target date for beginning repository operations from 1998 to 2003.

5497 **(GAO/RCED—87-103FS) Nuclear waste: Status of DOE's nuclear waste site characterization activities.** (General Accounting Office, Washington, DC (USA)). 1987. 41p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Three potential nuclear waste repository sites have been selected to carry out characterization activities-the detailed geological testing to determine the suitability of each site as a repository. The sites are Hanford in south-central Washington State, Yucca Mountain in southern Nevada, and Deaf Smith in the Texas Panhandle. Two key issues affecting the total program are the estimations of the site characterization completion data and costs and DOE's relationship with the Nuclear Regulatory Commission which has been limited and its relations with affected states and Indian tribes which continue to be difficult.

5498 **(GAO/RCED—87-139FS) Nuclear waste: Quarterly report on DOE's Nuclear Waste Program as of March 31, 1987.** (General Accounting Office, Washington, DC (USA)). 1987. 24p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Nuclear Waste Policy Act established a national program and policy for safely storing, transporting, and disposing of nuclear waste. This fact sheet provides the status of the Depart-

ment of Energy's program activities. They include (1) the release of a draft amendment to the mission plan in which DOE extends by 5 years its target date for beginning first repository operations and information on DOE's decision to postpone site-specific activities for the second repository; (2) a monitored retrievable storage proposal and related documents; (3) receipts of comments from utilities, state regulators, and others on its Notice of Inquiry on proposals for the calculation of fees for defense waste disposal; and (4) information on the Nuclear Waste Fund collection of over /135.4 million in fees and investment income and obligations of $139 million for program activities. The fund balance as of March 31, 1987, was about $1.5 billion.

5499 **(GSF—30/86) Laboratory investigations of non-saliniferous backfilling materials for the Konrad shaft.** Haensel, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). Aug 1986. 41p. (In German). (GSF-T—249). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751006/JAW.

Investigations on the suitability of materials backfilling and sealing caverns for use as a waste repository, the properties of a solid, reddish-brown iron oolite (A) and of a gray, largely homogeneous, non-stratified clay marl or lime marl (B) from various parts of the Konrad shaft have been studied (grain size, water content, filling density, compactness under conditions of loosest or tightest packing, Proctor compactness, shear resistance, permeability subsidence under pressure). The results show: (1) Material (B) is superior over (A) with regard to long-term safety (porosity between 16 and 19%); (2) material (A) is better than (B) with regard to supporting capacities, as it is less compressable under higher loads and has better resistance modules.

5500 **(HEDL-SA—3605) Environmentally-assisted cracking behavior of a high level nuclear waste container alloy.** James, L.A.; Duncan, D.R. (Hanford Engineering Development Lab., Richland, WA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1987. Contract AC06-76FF02170. 16p. (CONF-871168—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014384/JAW.

From International symposium on environmentally-assisted cracking; Bal Harbour, FL, USA (9 Nov 1987).

The environmentally assisted cracking behavior of cast American Society for Testing and Materials A27 steel in a simulated groundwater environment was studied using both statically loaded and cyclically loaded specimens. Compared to other aqueous environments, the groundwater environment is relatively nonaggressive, probably because of its high pH and low level of dissolved oxygen. 18 refs., 5 figs., 1 tab.

5501 **(HMI-B—424) Phase formation during corrosion experiments with two simulated borosilicate nuclear waste glasses.** Haaker, R.F. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). Oct 1985. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750542/JAW.

Corrosion products resulting from the reaction of simulated high-level radioactive waste glasses with various solutions have been identified. At 200degC, in saturated NaCl, a degree of reaction of 10 g C31-3 glass or 2.6 g SON 68 glass per liter of solution was obtained. Analcime, vermiculite (a phyllosilicate) and a 2:1 zinc silicate are the major silica containing alteration products for the C31-3 glass. Analcime was the only silicate alteration product which could be identified for SON 68 glass. C31-3 glass appeared to be less reactive with a quinary brine containing Mg/sup ++/ than with NaCl. With the quinary brine, montmorillonite (a phyllosilicate) was the predominant silica containing alteration product. Hydrotalcite (a Mg-Al hydroxysulfate) and montmorillonite were the major Al-containing phases. A phyllosilicate, probably montmorillonite, was observed to form during the reaction of SON 68 glass with quinary brine. With either glass, modified NaCl brines which contained small amounts of MgCl/sub 2/ seem to have the effect of decreasing the amount of analcime and increasing the amount of phyllosilicate which is formed. In the case of C31-3 glass, there is approximately enough Mg, Al and Zn to precipitate most of the leached Si; measured Si concentrations remain well below that expected for amorphous silica. SON 68 glass has less Zn, Al and Mg than C31-3 glass and much higher Si concentrations of the leachates.

5502 **(INIS-XN—81) Chernobyl and the safety of nuclear reactors in OECD countries.** (Nuclear Energy Agency, 75 - Paris (France)). 1987. 97p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700670/JAW.

Also published in French.

This report assesses the possible bearing of the Chernobyl accident on the safety of nuclear reactors in OECD countries. It discusses analyses of the accident performed in several countries as well as improvements to the safety of RBMK reactors announced by the USSR. Several remaining questions are identified. The report compares RBMK safety features with those of commercial reactors in OECD countries and evaluates a number of issues raised by the Chernobyl accident.

5503 **(LA—11135-MS) Environmental status of Technical Area 49, Los Alamos, New Mexico.** Purtymun, W.D.; Stoker, A.K. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000954/JAW.

A series of experiments involving high explosives and radioactive materials were conducted at Los Alamos, New Mexico, primarily to understand certain safety aspects of operational nuclear weapons. The experiments were conducted underground in large diameter holes as deep as 120 ft. The location was selected because it had geologic and hydrologic characteristics that assured complete containment of the experiments and precluded any possible contamination of groundwater. Important features verified by the USGS included the absence of any recharge and about 1200 feet of dry rock above the groundwater aquifer. Residual materials dispersed by detonation of the high explosives remain at the bottom of the experimental holes. The materials of significance from an environmental standpoint include about 40 kg of plutonium, 93 kg of enriched uranium, at least 82 kg of depleted uranium, 13 kg of beryllium, and an undetermined amount of lead. Environmental monitoring has been carried out regularly since the time of the experiments. Results of measurements confirm that there has been no contamination of groundwater. Minor surface soil contamination dating from the time of the experimental operations has been detected in small surface drainages near the experimental area. None of the surface contamination has been measurable at Laboratory boundaries or points of public access on a state highway. 14 refs., 8 figs.

5504 **(LBL—23638) Release rates from waste packages in a salt repository.** Chambre, P.L.; Hwang, Y.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 6p. (CONF-871101—60; UCB-NE—4102). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014082/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

In this report we present estimates of radionuclide release rates from waste packages into salt. This conservative and bounding analysis shows that release rates from waste packages in salt are well below the US Nuclear Regulatory Commission's performance objectives for the engineered barrier system. 2 refs., 2 figs.

5505 **(NAGRA-NTB—28) Determination of distribution coefficients (Kd-values) for the absorption of Cs and Sr on possible additives to mineral solidification materials.** Laske, D. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1979. 110p. (In German). Nagra, CH-5401 Baden, Switzerland.

The conditioning processes for low- and intermediate-level radioactive wastes from nuclear power plants include solidification by mineral binders prior to final disposal. Portland cement is generally used for this purpose. Other candidates are other types of cement, mortar mixtures, gypsum, and anhydrite binders. Besides

adequate mechanical strength, leaching stability in water solutions is the most important criterion for optimum solidification. The imbedded activities (nuclides) should as far as possible be retained in the matrix when water intrudes into a waste repository. The nuclides with the highest solubility are cesium and strontium. These fission products (Cs-137 and 134, Sr-90) also constitute the principal activity in the mentioned wastes. An essential reduction of the leaching rates of mineral solids can be reached through additions of materials which absorb cesium and strontium. Switzerland has a strong mineral content in ground waters. The water will be almost saturated with Ca(OH)/sub 2/ (lime) and/or CaSO/sub 4/ (gypsum) during the leaching process in the immediate proximity of the solids. The absorption of cesium and strontium has been investigated with a large variety of possible additions to mineral solidification materials both in pure distilled water and in solutions saturated with Ca(OH)/sub 2/ and CaSO/sub 4/.

5506 **(NAGRA-NTB—80-01) Project study for the final disposal of intermediate toxicity radioactive wastes (low- and intermediate-level radioactive wastes) in geological formations.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1980. 118p. (In German). Nagra, CH-5401 Baden, Switzerland.

The present report aimed to show variations in the construction- and operation-technical feasibility of a final repository for low- and intermediate-level radioactive wastes. This report represents the summary of a project study given under contract by Nagra with a view to informing a broader public of the technical conception of a final repository. Particular stress was laid on the treatment of the individual system elements of a repository concept during the construction, operation and sealing phases. The essential basis for the project study is the origin, composition and quantity of the wastes to be disposed. The final repository described in this report is foreseen for the reception of the following low- and intermediate-level solid radioactive wastes: wastes from the nuclear power plant operation; secondary wastes from the reprocessing of nuclear fuels; wastes from the decommissioning of nuclear power plants; wastes from research, medicine and industry.

5507 **(NAGRA-NTB—85-02) Exploratory borehole Boettstein: geology. Text volume.** Peters, Tj.; Matter, A.; Blaesi, H.R.; Gautschi, A. (Bern Univ., Switzerland; Geologisches Buero Dr. H. Jaeckli AG, Zuerich). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1986. 230p. (In German). Nagra, CH-5401 Baden, Switzerland.

Nagra, the National Cooperative for the Storage of Radioactive Waste, is carrying out a comprehensive geological research programme in Northern Switzerland. The Boettstein well was the first borehole in the drilling programme. Its total depth is 1501 m. Drilling operations at Boettstein started in October 1982 and continued until june 1983. Both sediment and basement rocks were continuously cored. The cores from the Boettstein well were studied in detail both at the drill-site and in the laboratory. Apart from stratigraphic, sedimentologic, mineralogic and petrographic studies, the investigations included structural mapping of the cores, absolute and mercury injection porosimetry, permeability, fluorescence microscopy, specific surface, cation exchange capacity, thermal conductivity, geomechanic properties, main and trace element analysis, stable and radioactive isotope analysis, fluid inclusion studies, maturation of organic material (in sediments oonly). The present report contains a complete synopsis of the data obtained up to October 1984. They are interpreted with regard to a reconstruction of the geological evolution of the Boettstein area and with regard to a characterization of ground-water flow systems in sedimentary and crystalline rocks. The report also contains comments on the methodology applied.

5508 **(NAGRA-NTB—86-12) Bentonite as backfilling material in the final repository for high-level radioactive waste: chemical aspects.** Grauer, R. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1985. 187p. (In German). Nagra, CH-5401 Baden, Switzerland.

The present Nagra concept for disposal of high-level waste foresees emplacing the steel containers enclosing the borosilicate glass in tunnels of 3.7 m diameter at a depth of 1000 to 1500 m. These tunnels are to be backfilled with compacted bentonite, a clay with a high montmorillonite content. Bentonites are suitable as a backfill due to, inter alia, their swelling capability, their low hydraulic conductivity and their sorption properties. This report is restricted to those chemical aspects of the backfill material which can affect the behaviour of a repository system: swelling capability, sorption properties and long-term stability. Under repository conditions, the swelling of montmorillonite upon water inflow is primarily intercrystalline. At present, there is no microscopic model which gives a quantitative description of this process. However, on the basis of equilibrium thermodynamics, relationships can be deduced between swelling pressure and experimentally more easily determinable water vapour sorption isotherms and heats of immersion. Cation adsorption, which is important for nuclide retention in the repository, can be described by appropriate models. However, for various reasons, interpretation of published sorption data is rarely possible from a theoretical viewpoint and direct diffusion measurements on compacted bentonite are therefore preferable to the use of sorption data. Because of its better stability, a calcium bentonite is preferable to the sodium variant. A low iron content is desirable because, under reducing conditions, the surface charge of the montmorillonite is increased by by reduction of iron (III). Organic and sulphidic contaminants should also be kept to a minimum.

5509 **(NAGRA-NTB—86-20) Stripa project annual report 1985.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1986. 34p. Nagra, CH-5401 Baden, Switzerland.

The Stripa Project is organised as an autonomous project of the Nuclear Energy Agency of the OECD. In the period from 1980-86, an international cooperative programme of investigations is being carried out in an underground rock laboratory in Sweden. The aim of the work is to improve our knowledge in the following areas: - hydrogeological and geochemical measurement methods in boreholes - flow of groundwater and transport of radionuclides in fissured rock - behaviour of backfilling and sealing materials in a real geological environment - non-destructive methods for location of disturbed zones in the rock. Switzerland is represented in the Stripa Project by Nagra and the Stripa Project technical reports appear in the Nagra NTB series.

5510 **(NUREG/CR—4134-R2) Repository environmental parameters and models/methodologies relevant to assessing the performance of high-level waste packages in basalt, tuff, and salt.** Claiborne, H.C.; Croff, A.G.; Griess, J.C.; Smith, F.J. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 244p. (ORNL/TM—9522-R2). NTIS, PC A11/MF A01 - GPO. Order Number TI87013729/JAW.

This document provides specifications for models/methodologies that could be employed in determining postclosure repository environmental parameters relevant to the performance of high-level waste packages for the Basalt Waste Isolation Project (BWIP) at Richland, Washington, the tuff at Yucca Mountain by the Nevada Test Site, and the bedded salt in Deaf Smith County, Texas. Guidance is provided on the identify of the relevant repository environmental parameters; the models/methodologies employed to determine the parameters, and the input data base for the models/methodologies. Supporting studies included are an analysis of potential waste package failure modes leading to identification of the relevant repository environmental parameters, an evaluation of the credible range of the repository environmental parameters, and a summary of the review of existing models/methodologies currently employed in determining repository environmental parameters relevant to waste package performance. 327 refs., 26 figs., 19 tabs.

5511 **(NUREG/CR—4701-Vol.2) Safety assessment of alternatives to shallow-land burial of low-level radioactive waste: Volume 2, Environmental conditions affecting reliability of engineered barriers.** Cerven, F.; Otis, M.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 46p. (EGG—2465). NTIS, PC A03/MF A01 - GPO. Order Number TI88001544/JAW.

The need for new disposal capacity for low-level radioactive waste (LLW) has led to a re-examination of disposal practices. A number of enhancements and alternatives to traditional shallow-land burial have been proposed to meet the need for new capacity and to address various concerns about the performance history of existing commercial LLW sites. Fifteen potentially important degradation mechanisms for a LLW facility are identified, categorized, and analyzed to determine their importance to the proper functioning of the disposal facility over its 500-year lifetime. Wind storms, biological intrusion, mechanical settling, freeze/thaw cycling, chemical degradation, wind erosion, and water erosion were considered the most important mechanisms. Data supporting concrete structure long-term performance in sulfate environments and long-term cover performance in erosive and biological intrusion environments were obtained. Research on the performance of covers and concrete structures in the presence of the other listed degradation mechanisms is recommended. 18 refs., 16 figs., 9 tabs.

5512 **(ORNL—6317) Cleanup procedures at the Nevada Test Site and at other radioactively contaminated sites including representative costs of cleanup and treatment of contaminated areas.** Talmage, S.S.; Chilton, B.D. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 50p. (NVO/AEIC—306). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001405/JAW.

This review summarizes available information on cleanup procedures at the Nevada Test Site and at other radioactively contaminated sites. Radionuclide distribution and inventory, size of the contaminated areas, equipment, and cleanup procedures and results are included. Information about the cost of cleanup and treatment for contaminated land is presented. Selected measures that could be useful in estimating the costs of cleaning up radioactively contaminated areas are described. 76 refs., 16 tabs.

5513 **(ORNL/Sub—85-97343/2) Thermomechanical properties of selected shales.** Hansen, F.D.; Vogt, T.J. (RE/SPEC, Inc., Rapid City, SD (USA)). Aug 1987. Contract AC05-84OR21400. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001509/JAW.

The experimental work discussed in this report is part of an ongoing program concerning evaluation of sedimentary and other rock types as potential hosts for a geologic repository. The objectives are the development of tools and techniques for repository characterization and performance assessment in a diversity of geohydrologic settings. This phase of the program is a laboratory study that investigates fundamental thermomechanical properties of several different shales. Laboratory experiments are intrinsically related to numerical modeling and in situ field experiments, which together will be used for performance assessment.

5514 **(ORNL/Sub—86-32136/1) Installation and sampling of vadose zone monitoring devices.** Bergeron, S.M.; Strickland, D.J.; Pearson, R. (Golder Associates, Inc., Atlanta, GA (USA)). Oct 1987. Contract AC05-84OR21400. 70p. NTIS, PC A04. Order Number DE88002152/JAW.

A vadose zone monitoring system was installed in a sanitary landfill near the Y-12 facility on the Department of Energy's Oak Ridge, Tennessee Reservation. The work was completed as part of the LLWDDD program to develop, design, and demonstrate new low level radioactive waste disposal monitoring methods. The objective of the project was to evaluate the performance of three types of vadose zone samplers within a similar hydrogeologic environment for use as early detection monitoring devices. The three different types of samplers included the Soil Moisture Equipment Corporation Pressure-Vacuum samplers (Models 1920 and 1940), and the BAT Piezometer (Model MK II) manufactured by BAT Envitech, Inc. All three samplers are designed to remove soil moisture from the vadose (unsaturated) zone. Five clusters of three holes each were drilled to maximum depths of 45 ft around part of the periphery of the landfill. Three samplers, one of each type, were installed at each cluster location. Water samples were obtained from 13 of the 15 samplers and submitted to Martin Marietta for analysis. All three samplers performed satisfactorily when considering ease of installation, required in-hole development, and ability to collect water samples from the vadose zone. Advantages and disadvantages of each sampler type are discussed in the main report.

5515 **(ORNL/TM—9954) Performance objectives for disposal of low-level radioactive wastes on the Oak Ridge Reservation.** Kocher, D.C. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001530/JAW.

This report presents a set of performance objectives for disposal of low-level radioactive wastes in a new facility on the Oak Ridge Reservation. The principal performance objectives include a limit on annual committed effective dose equivalent averaged over a lifetime of 0.25 mSv (25 mrem) for any member of the public beyond the boundary of the disposal facility, and a limit on annual committed effective dose equivalent averaged over a lifetime of 1 mSv (0.1 rem) and a limit on committed effective dose equivalent in any year of 5 mSv (0.5 rem) for any individual who inadvertently intrudes onto the disposal site after loss of active institutional controls. In addition, releases of radioactivity beyond the site boundary shall not result in annual dose equivalents to any number of the public from all sources of exposure that exceed limits established by Federal regulatory authorities and shall be kept as low as reasonably achievable. This report reviews generally applicable radiation protection standards for the public and environmental radiation standards for specific practices that have been developed by national and international authorities and discusses the use of limits on risk rather than dose as performance objectives and consideration of chemical toxicity rather than radiation dose in establishing limits on intakes of uranium. 63 refs., 7 figs., 2 tabs.

5516 **(ORNL/TM—10228) Developing a strategy and closure criteria for radioactive and mixed waste sites in the ORNL remedial action program: Regulatory interface.** Trabalka, J.R. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001526/JAW.

Some options for stabilization and treatment of contaminated sites can theoretically provide a once-and-for-all solution (e.g., removal or destruction of contaminants). Most realizable options, however, leave contaminants in place (in situ), potentially isolated by physical or chemical, but more typically, by hydrologic measures. As a result of the dynamic nature of the interactions between contaminants, remedial measures, and the environment, in situ stabilization measures are likely to have limited life spans, and maintenance and monitoring of performance become an essential part of the scheme. The length of formal institutional control over the site and related questions about future uses of the land and waters are of paramount importance. Unique features of the ORNL site and environs appear to be key ingredients in achieving the very long term institutional control necessary for successful financing and implementation of in situ stabilization. Some formal regulatory interface is necessary to ensure that regulatory limitations and new guidance which can affect planning and implementation of the ORNL Remedial Action Program are communicated to ORNL staff and potential technical and financial limitations which can affect schedules or alternatives for achievement of long-term site stabilization and the capability to meet environmental regulations are provided to regulatory bodies as early as possible. Such an interface should allow decisions on closure criteria to be based primarily on technical merit and protection of human health and the environment. A plan for interfacing with federal and state regulatory authorities is described. 93 refs., 1 fig., 4 tabs.

5517 (ORNL/TM—10535) **Geochemistry of shale groundwaters: Results of preliminary laboratory leaching experiments.** Von Damm, K.L.; Johnson, K.O. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001514/JAW.

Twelve shales were reacted with distilled water at 20°C and 100°C; the composition of the waters and the mineralogy were determined before and after reaction. The experiments were conducted in a batch mode over a period of approximately 40 days. Major changes occurred in the solution chemistry; in most cases sulfate became the dominant anion while either sodium or calcium was the major cation. The high sulfate is most likely a result of the oxidation of pyrite in the samples. In the 100°C experiments some of the solutions became quite acidic. Examination of the observed mineralogy and comparison to the mineral assemblage calculated to be in equilibrium with the experimentally determined waters, suggests that the acidic waters are generated when no carbonate minerals remain to buffer the groundwaters to a more neutral pH. The pH of shale waters will be determined by the balance between the oxidation of pyrite and organic matter and the dissolution of carbonate minerals. The experimental data are helping to elucidate the chemical reactions that control the pH of shale groundwaters, a critical parameter in determining other water-rock and waste-water-rock interactions and ultimate solute mobility. An experimental approach also provides a means of obtaining data for shales for which no groundwater data are available as well as data on chemical species which are not usually determined or reported.

5518 (ORNL/TM—10562) **Preliminary creep and pillar closure data for shales.** Lomenick, T.F.; Russell, J.E. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001512/JAW.

The results of fourteen laboratory creep tests on model pillars of four different shales are reported. Initial pillar stresses range from 6.9 MPa (1000 psi) to 69 MPa (10,000 psi) and temperatures range from ambient to 100°C. Laboratory response data are used to evaluate the parameters in the transient power-law pillar closure equation similar to that previously used for model pillars of rock salt. The response of the model pillars of shale shows many of the same characteristics as for rock salt. Deformation is enhanced by higher stresses and temperatures, although the shale pillars are not as sensitive to either stress or temperature as are pillars of rock salt. These test results must be considered very preliminary since they represent the initial, or scoping, phase of a comprehensive model pillar test program that will lead to the development and validation of creep laws for clay-rich rocks. 11 refs., 9 figs., 7 tabs.

5519 (PB—87-227559/XAB) **Prediction of vertical transport of low-level radioactive Middlesex soil at a deep-ocean disposal site. Final report, 1 January 1984-30 April 1985.** Bonner, J.S.; Hunt, C.D.; Paul, J.F.; Bierman, V.J. (Office of Radiation Programs, Washington, DC (USA)). Sep 1986. 71p. (EPA—520/1-86/016). NTIS, PC A04/MF A01.

Also pub. as Environmental Research Lab., Narragensett, RI. CONTRIB-721.

A combined experimental and modeling approach was conducted within the framework of the hazard assessment-methodology developed at the EPA Environmental Research Laboratory Narragansett. Experimentation was conducted to characterize Middlesex soil in terms of particle-size distribution, specific gravity, radioactivity, and soluble phase equilibria. In addition, dynamic settling velocity distributions were measured. The data derived from the experimental work were synthesized using a modeling approach that emphasized the vertical convective-diffusive transport of a polydispersed suspension of particles.

5520 (PB—87-228052/XAB) **Estimates of the quantities, form, and transport of carbon-14 in low-level radioactive waste. Final report.** Gruhlke, J.M.; Neiheisel, J.; Battist, L. (Office of Radiation Programs, Washington, DC (USA)). Sep 1986. 36p. (EPA—520/1-86/019). NTIS, PC A03/MF A01.

Analysis of the activity level of C-14 contributed from the nuclear fuel cycle and non-fuel sources to LLW sites in the period from 1985-2004 provides the following information: 2100 Ci from the nuclear fuel cycle; 1650 Ci from institutional wastes; 2150 Ci from industrial wastes. The chemical form of the C-14 in the fuel cycle waste approximates 75% inorganic (carbonate), 20% activation metal, and 5% organic radiocarbons. The chemical form of the institutional and industrial carbon-14 waste is believed to be essentially 100% organic radiocarbon compounds. The transport of C-14 from the low-level radioactive waste site is believed to be largely as a gaseous release to the atmosphere.

5521 (PNL—5904-4) **LFCM [liquid-fed ceramic melter] vitrification technology: Quarterly progress report, July-September 1986.** Burkholder, H.C.; Allen, C.R. (comps.); Andersen, C.M.; Bates, S.O.; Dierks, R.D.; Faletti, D.W.; Farnsworth, R.K.; Goles, R.W.; Kuhn, W.L.; Nakaoka, R.K. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87013123/JAW.

Individual papers are processed separately for the data bases. This report documents progress on liquid-fed ceramic melter (LFCM) vitrification technology. Progress in melting process chemistry and glass development, feed preparation and transfer systems, melter systems, off-gas systems, and process/product modeling and control is discussed.

5522 (PNL—5904-4, pp 5-12) **Melting process chemistry and glass development.** Bates, S.O. Jun 1987. NTIS, PC A04/MF A01. Order Number DE87013123/JAW.

In LFCM [liquid-fed ceramic melter] vitrification technology: Quarterly progress report, July-September 1986.

An evaluation was made of the changes in critical glass and melt properties due to varying of U_3O_8 content in the total waste fraction of the Hanford Waste Vitrification Plant (HWVP) reference glass. The range for U_3O_8 variability in the test was 0 to 8 wt % in the glass, while total waste loading was kept at 25 wt %. Six glasses with U_3O_8 levels of 0, 0.15, 2, 4, 6, and 8 wt % were evaluated. The uranium variability in the range expected will not significantly affect viscosity, electrical conductivity, or durability of the glass. Uranium variability should not be included in the composition variability study for defining the operational envelope of the glass. 4 tabs.

5523 (PNL—5904-4, pp 13-22) **Feed preparation and transfer systems.** Peterson, M.E.; Nakaoka, R.K. Jun 1987. NTIS, PC A04/MF A01. Order Number DE87013123/JAW.

In LFCM [liquid-fed ceramic melter] vitrification technology: Quarterly progress report, July-September 1986.

An experimental Nuclear Waste Treatment Program test plan for evaluating the heating and cooling requirements of a simulated melter feed slurry was prepared and approved. The purpose is to determine whether a steam jacket or coil for the mixing tank will better provide the necessary heat transfer area and to develop a model to predict the heat transfer based on the slurry properties. The experimental data will be scaled up to predict the heat transfer in a large-scale mixing tank. A letter report was completed and issued documenting the results of extensive pilot-scale pipe-loop experiments to determine the critical velocity of a fully suspended slurry that will resuspend sludge in horizontal pipes. 1 ref., 2 figs.

5524 (PNL—5904-4, pp 23-28) **Melter systems.** Perez, J.M. Jr.; Dierks, R.D.; Nakaoka, R.K.; Goles, R.W. Jun 1987. NTIS, PC A04/MF A01. Order Number DE87013123/JAW.

In LFCM [liquid-fed ceramic melter] vitrification technology: Quarterly progress report, July-September 1986.

Analyses of test results from two nonradioactive high-bay ceramic melter (HBCM) experiments were completed. Nonradioactive melter testing conducted during FY 1986 tested melter feed concentration and composition variability. Based on the first HBCM experiment, PNL recommended that the total oxide loading of the reference HWVP melter feed be increased from 400 grams total oxide per liter (g TO/L) to 500 g TO/L. A second experiment demonstrated that concentrational variations of key reference feed components over the ranges tested did not adversely affect the processing characteristics of HWVP melter feed. Components

tested included sodium, iron and zirconium. Repairs and modifications to ancillary systems of the radioactive liquid-fed ceramic melter (RLFCM) were completed, permitting melter run RLFCM-7 to be restarted. 4 refs., 2 tabs.

5525 (PNL—5904-4, pp 29-50) **Off-gas systems.** Goles, R.W.; Andersen, C.M. Jun 1987. NTIS, PC A04/MF A01. Order Number DE87013123/JAW.

In LFCM [liquid-fed ceramic melter] vitrification technology: Quarterly progress report, July-September 1986.

Data from over 20 liquid-fed ceramic melter (LFCM) tests, involving 3000 h of nonradioactive processing with simulated wastes, were reviewed to identify mechanisms controlling the volatility and capture of cesium during vitrification. This study concluded that the mechanism responsible for melter cesium losses has proved insensitive to many LFCM operating and processing variables. Variations in inleakage, plenum temperature, feeding rate, and waste loading do not significantly influence melter cesium performance. Feed composition, specifically halogen content, is the only processing variable identified that has had a significant effect. Because LFCM-generated aerosols are submicron in size, melter disengagement design features are not expected to be particularly effective in reducing cesium emission rates. For the same reason, the cesium removal performance of conventional quench scrubbers is quite low, being dependent only upon the amount of melter entrainment losses. Although a deep-bed washable filter has effectively removed submicron aerosols from the process exhaust, high performance has been achieved only under dry operating conditions. The melter's idling state appears to place no additional demands on the off-gas treatment system. 3 refs., 5 figs., 10 tabs.

5526 (PNL—5904-4, pp 51-59) **Process/product modeling and control.** Kuhn, W.L.; Faletti, D.W.; Peters, R.D.; Pulsipher, B.A.; Reimus, P.W. Jun 1987. NTIS, PC A04/MF A01. Order Number DE87013123/JAW.

In LFCM [liquid-fed ceramic melter] vitrification technology: Quarterly progress report, July-September 1986.

A mass balance simulation model of the West Valley vitrification plant is being developed. The three overall objectives are to predict the composition of nuclear waste glass produced at West Valley based on a knowledge of process conditions (i.e., from process measurements); to generate simulated data that provide a measure of the uncertainty in the predicted glass composition based on knowledge of uncertainties in process measurements; and to generate simulated data that provide a measure of the inherent variability in the glass composition as a function of the inherent variability in the feed composition. Installation, debugging, and testing were completed on the implicit viscous diffusion algorithm in the latest QA version (N-29) of TEMPEST, which is being applied to predict temperatures of molten glass cooling in a canister. ! ref.

5527 **(PNL—6329) Spent nuclear fuel as a waste form for geologic disposal: Assessment and recommendations on data and modeling needs.** Van Luik, A.E.; Apted, M.J.; Bailey, W.J.; Haberman, J.H.; Shade, J.S.; Guenther, R.E.; Serne, R.J.; Gilbert, E.R.; Peters, R.; Williford, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 271p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88001692/JAW.

This study assesses the status of knowledge pertinent to evaluating the behavior of spent nuclear fuel as a waste form in geologic disposal systems and provides background information that can be used by the DOE to address the information needs that pertain to compliance with applicable standards and regulations. To achieve this objective, applicable federal regulations were reviewed, expected disposal environments were described, the status of spent-fuel modeling was summarized, and information regarding the characteristics and behavior of spent fuel was compiled. This compiled information was then evaluated from a performance modeling perspective to identify further information needs. A number of recommendations were made concerning information still needed to enhance understanding of spent-fuel behavior as a waste form in geologic repositories. 335 refs., 22 figs., 44 tabs.

5528 **(PNL—6331) Review of hydrodynamic and transport models and data collected near the mid-Atlantic low-level radioactive waste disposal sites.** Onishi, Y.; Hibler, L.F.; Sherwood, C.R. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001693/JAW.

The objectives of this study were to (1) briefly review and evaluate available simulation models that may be used to predict the distribution of low-level radioactive waste (LLW) from the 2800-m and 3800-m Low Level Radioactive Disposal Sites in the Mid-Atlantic Continental Slope and Rise on a regional (a few hundred kilometers square) scale, (2) identify pertinent physical, biological, and geological oceanographic data in or near those LLW disposal sites, and (3) determine minimum data requirements for regional modeling. With suitable model modifications such as turbulence closure, enhanced sediment transport, radionuclide transport, and/or curvilinear coordinate system setup, the FLESCOT model, the FLOWER model, and Blumberg's model would be appropriate candidates for regional radionuclide modeling to predict the transport and dispersion of LLW disposed in the 2800-m and 3800-m sites. Although the RMA10 model does not incorporate a turbulence closure scheme, this model, with some modifications, is also an appropriate candidate for regional radionuclide modeling. FLESCOT is currently the only one that solves distributions of flow, turbulence, salinity, water temperature, sediments, dissolved contaminants, and sediment-sorbed contaminants. Thus, the FLESCOT model is recommended to be applied to the 2800-m and 3800-m sites to predict the transport and accumulation of LLW on a regional scale.

5529 **(PNL-SA—14314) AREST [Analytical Repository Source-Term]: A probabilistic source-term code for waste package performance analysis.** Liebetrau, A.M.; Apted, M.J.; Engel, D.W.; Altenhofen, M.K.; Reid, C.R.; Strachan, D.M.; Erikson, R.L.; Alexander, D.H. (Pacific Northwest Lab., Richland, WA (USA); USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Feb 1987. Contract AC06-76RL01830. 30p. (CONF-870306—67). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88000987/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The engineered barrier system is the first of several manmade and natural barriers to the release and migration of radioactive wastes from a geologic repository to the accessible environment. The Analytical Repository Source-Term (AREST) code has been developed to provide a quantitative assessment of the performance of the EBS and individual barriers thereof relative to the regulatory requirements for the isolation of nuclear wastes. The AREST code integrates mechanistic models of chemical and physical process that affect radionuclide release into a unified probabilistic framework. 30 refs., 3 figs.

5530 **(PNL-SA—14592) The adaption and use of research codes for performance assessment.** Liebetrau, A.M. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 17p. (CONF-861141—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000552/JAW.

From 4. meeting of the Probabilistic Systems Assessment Codes User Group; London, UK (10 Nov 1986).

Models of real-world phenomena are developed for many reasons. The models are usually, if not always, implemented in the form of a computer code. The characteristics of a code are determined largely by its intended use. Realizations or implementations of detailed mathematical models of complex physical and/or chemical processes are often referred to as research or scientific (RS) codes. Research codes typically require large amounts of computing time. One example of an RS code is a finite-element code for solving complex systems of differential equations that describe mass transfer through some geologic medium. Considerable computing time is required because computations are done at many points in time and/or space. Codes used to evaluate the overall performance of real-world physical systems are called performance assessment (PA) codes. Performance assessment codes are used to conduct sim-

ulated experiments involving systems that cannot be directly observed. Thus, PA codes usually involve repeated simulations of system performance in situations that preclude the use of conventional experimental and statistical methods. 3 figs.

5531 **(PNL-SA—15093) Development of an international BRC [Below Regulatory Concern] limit.** Kennedy, W.E. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 14p. (CONF-870859—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000074/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The International Atomic Energy Agency (IAEA) has recently investigated the exemption from regulatory control of radiation sources containing limited quantities of radioactive materials. Early efforts were entitled de minimis and were aimed at establishing a philosophical basis and radiation dose limits. The main objectives of more recent work on exemption are to illustrate a method for developing practical radiological criteria, to establish generic criteria, and to determine the practicability of the preliminary exemption principles. The method used to develop the criteria relies on models to evaluate the potential radiation exposure pathways and scenarios for individuals and population groups potentially present following the unrestricted release of materials. This paper describes the assessment methods, presents the generic results expressed in terms of the limiting concentrations of selected radionuclides in municipal waste, and provides a comparison with recent regulatory efforts in the United States for considering selected wastes being Below Regulatory Concern (BRC). 17 refs., 4 tabs.

5532 **(PNL/SRP—6284) Data report on leach tests of Pu-doped UO_2 in PBB1 brine: Salt Repository Project.** Gray, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002091/JAW.

This report provides results from a series of leach tests conducted using nonirradiated uranium dioxide (UO_2) doped with plutonium (Pu) to simulate the alpha activity of spent fuel specimens used in recent spent fuel leach tests. The purpose was to determine whether alpha radiation from the spent fuel could be responsible for uranium release values in spent fuel leach tests in salt brine that were at least 100 times greater than from similar tests with nonirradiated UO_2 pellets. The data in this data report are preliminary; they have been neither analyzed nor evaluated. 2 refs., 2 figs., 8 tabs.

5533 **(PTB-SE—18) Yield of radioactive wastes in the Federal Republic of Germany - waste survey for the year 1986.** Brennecke, P.; Schumacher, J. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle). May 1987. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751034/JAW.

On December 31, about 67600 waste packages were stored in interim storage facilities. The unconditioned radioactive wastes amounted to about 6600 m/sup 3/. The volume of the conditioned radioactive wastes amounted to about 33900 m/sup 3/. Thereof the waste from nuclear research establishments made up about 13300 m/sup 3/, the waste from the operation of nuclear power plants about 10700 m/sup 3/ and the waste from reprocessing of spent fuel elements about 6700 m/sup 3/. In addition the future amount of conditioned radioactive wastes with negligible heat generation was prognosticated. According to this forecast, the waste package volume will be approximately in the order of 218200 m/sup 3/ up to the year 2000. In 1986 a capacity of about 97500 m/sup 3/ for the interim storage of radioactive wastes was available in the Federal Republic of Germany. On December 31, 1986, this capacity was utilized by unconditioned and conditioned radioactive wastes at an average of about 38%. It may be concluded from the data on the expected amount of radioactive wastes with negligible heat generation and on the utilization factor of the interim storage facilities that no bottlenecks are to be assumed up to the planned operation of the Konrad repository.

5534 **(SAND—84-7130) Spent-fuel consolidation system: Nevada Nuclear Waste Storage Investigations Project.** Townes, G.A.; Godfrey, W.L.; Anderson, K.J. (BE, Inc., Barnwell, SC (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001787/JAW.

This document describes a developmental study of equipment and operations for disassembling and packaging commercially generated light water reactor spent fuel. This fuel-consolidation study supports the conceptual design activities of the Nevada Nuclear Waste Storage Investigations project for the development of facilities at Yucca Mountain, Nevada, a candidate site for the disposal of radioactive waste. The study includes a review of current technology and existing equipment that potentially applies to a spent-fuel consolidation system. It generates a definition of the design bases for a consolidation system; provides recommendations for and descriptions of equipment and operations; and presents a design rationale, a staffing plan, and partial life-cycle cost estimates. 3 refs.

5535 **(SAND—85-7111) Installation of steel liner in blind hole study.** (Kenny Construction Co., Wheeling, IL (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 42p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001316/JAW.

Lining of horizontally bored, waste-emplacement holes has been studied for possible use in underground nuclear waste repositories. This study developed and evaluated a technically feasible concept for installing a steel liner in a 37-in.-diameter borehole up to 700 ft in length. This report reviews the history of jacking such lines in place, surveys existing equipment, reviews the cost estimate for this procedure, examines welding technology for the application, and concludes with a critical review of the construction risk. 9 figs., 1 tab.

5536 **(SAND—86-7078) Karst in evaporites in southeastern New Mexico.** Bachman, G.O. (Bachman (George O.), Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001315/JAW.

Permian evaporites in southeastern New Mexico include gypsum, anhydrite, and salt, which are subject to both blanket and local, selective dissolution. Dissolution has produced many hundreds of individual karst features including collapse sinks, karst valleys, blind valleys, karst plains, caves, and breccia pipes. Dissolution began within some formations during Permian time and has been intermittent but continual ever since. Karst features other than blanket deposits of breccia are not preserved from the early episodes of dissolution, but some karst features preserved today - such as breccia pipes - are remnants of karst activity that was active at least as early as mid-Pleistocene time. Rainfall was much more abundant during Late Pleistocene time, and many features visible today may have been formed then. The drainage history of the Pecos River is related to extensive karstification of the Pecos Valley during mid-Pleistocene time. Large-scale stream piracy and dissolution of salt in the subsurface resulted in major shifts and excavations in the channel. In spite of intensive groundwater studies that have been carried out in the region, major problems in near-surface evaporite karst remain to be solved. Among these are determination of recharge areas and time of recharge. 109 refs., 31 figs., 1 tab.

5537 **(SAND—86-7136) Site-generated waste treatment and disposal study.** Jardine, L.J.; Lipps, D.J.; Miller, D.D. (Bechtel National, Inc., San Francisco, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 225p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001932/JAW.

Secondary radioactive wastes will be generated during the normal operation of the Yucca Mountain Nuclear Waste Repository. The sources, quantities, and characteristics of these site-generated radioactive wastes are estimated, and available waste treatment and disposal technologies are evaluated. Technical and economic

comparisons are performed for 10 waste treatment options. Recommendations are given for the preferred waste treatment and disposal options based on these comparisons of the various alternatives. 42 refs., 38 figs., 23 tabs.

5538 **(SAND—87-0264) Crushed salt consolidation kinetics.** Yost, F.G.; Aronson, E.A. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001784/JAW.

The compaction of crushed salt is an important process in the sealing of a salt repository for nuclear wastes. Reported here is a simple phenomenological model of crushed slat compaction kinetics. The model is compared to experimental data. Very good least-squares fit can be made. The model allows correlation of experimental data, comparison with physical mechanisms for compaction, and the prediction of long-term compaction behavior. 14 refs., 10 figs., 1 tab.

5539 **(SAND—87-2048C) Numerical modeling of interactions between crushed and intact salt.** Sjaardema, G.D.; Krieg, R.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 22p. (CONF-8709171—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002222/JAW.

From Joint FRG/USA salt near-field geochemistry workshop; Albuquerque, NM, USA (22 Sep 1987).

The results of several analyses studying the interaction between intact salt and crushed salt in realistic field configurations, such as backfilled shafts and drifts, will be presented. The analyses use a volumetric creep model for wet crushed salt and an elastic-secondary creep model for the deviatoric behavior of intact salt. The material parameters for the wet crushed salt model are derived from hydrostatic consolidation tests performed on wet salt by Holcomb. The calculations show that the wet crushed salt does not significantly retard the rate of closure of shafts and drifts until the crushed salt is consolidated approximately 95% of intact salt density. The importance of the crushed salt deviatoric will be discussed. 9 refs., 24 figs.

5540 **(SAND—87-7067) User's guide to MARINRAD IV [Marine Radionuclide Transport and Dose]: Model for assessing the consequences of release of radioactive material into the oceans.** Ensminger, D.A.; Koplik, C.M.; Nalbandian, J.Y. (Analytic Sciences Corp., Reading, MA (USA)). Sep 1987. Contract AC04-76DP00789. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001447/JAW.

MARINRAD IV (Marine Radionuclide Transport and Dose) is a system of three FORTRAN '77 computer programs designed to evaluate the consequences of the release of radionuclides into the ocean. The program MARRAD computes nuclide concentration due to ocean transport and generates food chain concentration factors. The program MAROUT evaluates a pathways-to-man dose model, generates print reports, and produces graphic plots. The program ADJOINT applies the adjoint analysis technique for computing model parameter sensitivities. MARINRAD's topdown modular design provides flexible software which can be easily modified for a user's specific problem. 24 refs., 29 figs., 53 tabs.

5541 **(SAND—87-7077C) Repository design integration.** Monsees, J.E.; Streeter, W.S. (Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 22p. (CONF-870948—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000600/JAW.

From American Nuclear Society topical meeting on the integrated spent fuel and HLW management system; Albuquerque, NM, USA (27 Sep 1987).

Because the repository is the final component in the waste management system, the interactions tend to flow in one direction only, i.e., from reactor through to the repository. Therefore, the design of the repository must provide flexibility to respond to changes in program guidance, to variability in geologic characteristics, and to site specific requirements. Programmatic issues affecting design include waste type, quantity, burnup, and age; the existence of other system elements such as a monitored retrieval storage facility; consolidation of fuel elements; emplacement of other waste types; and schedule for first and second repository. In addition to programmatic decisions, site specific decisions such as waste emplacement geometry affect repository design. The approach has been to develop initial designs that provide flexibility and consider the program and design issues listed above. The next step in the program must be to resolve programmatic and site specific issues and thereby reduce the multiplicity of design efforts. 12 refs., 2 figs., 2 tabs.

5542 **(SKB-TR—86-15) Biosphere data base revision.** Bergstroem, U.; Andersson, K.; Sundblad, B. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1985. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750367/JAW.

The turnover of long-lived radionuclides in the biosphere has been modelled some time ago and the exposure to man was calculated. The nuclides were long-lived actinides and fission products leaking from a simulated deep rock repository for spent nuclear fuel. The data base for these calculations has been updated in the present work and in addition a number of nuclides that were not included in the earlier work have been treated. (G.B.).

5543 **(SKB-TR—86-26) Model shear tests of canisters with smectite clay envelopes in deposition holes.** Boergesson, L. (Swedish Geological Co., Lund). (Swedish Nuclear Fuel and Waste Management Co., Stockholm). 31 Dec 1986. 85p. (In English). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751041/JAW.

The consequences of rock displacement across a deposition hole has been investigated by some model tests. The model was scaled 1:10 to a real deposition hole. It was filled with a canister made of solid copper surrounded by highly compacted water saturated MX-80 bentonite. Before shear the swelling pressure was measured by six transducers in order to follow the water uptake process. During shear, pressure, strain, force and deformation were measured in altogether 18 points. The shearing was made at different rates in the various tests. An extensive sampling after shear was made through which the density, water content, degree of saturation, homogenization and the effect of shear on the bentonite and canister could be studied. One important conlusion from these tests was that the rate dependence is about 10% increased shear resistance per decade increased rate of shear. This resulted also in a very clear increase in strain in the canister with increased rate. The results also showed that the saturated bentonite has excellent stress distributing properties and that there is no risk of destroying the canister if the rock displacement is smaller than the thickness of the bentonite cover. The high density of the clay makes the bentonite produce such a high swelling pressure that the material will be very stiff. In the case of a larger shear deformation corresponding to ≈ 50% of the bentonite thickness the result will be a rather large deformation of the canister. A lower density would be preferable if it can be accepted with respect to other required isolating properties. The results also showed that three-dimensional FEM calculation using non-linear material properties is necessary to simulate the shear process. The rate dependence may be taken into account by adapting the properties to the actual rate of shear but might in a later stage be included in the model by giving the material viscous properties.

5544 **(UCRL—95330) Geophysical tomography for imaging water movement in welded tuff.** Daily, W.D.; Ramirez, A.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 5p. (CONF-8609350—1). NTIS, PC A02. Order Number DE87013108/JAW.

From 2. international conference on nuclear waste management; Winnipeg, Canada (1 Sep 1986).

Alterant tomography has been evaluated for its ability to delineate in-situ water flow paths in a fractured welded-tuff rock mass. The evaluation involved a field experiment in which tomographs of electromagnetic attenuation factor (or attenuation rate) at 300 MHz were made before, during, and after the introduction to the rock of two different water-based tracers: a plain water and dye solution, and salt water and dye. Alterant tomographs were con-

structed by subtracting, cell by cell, the attenuation factors derived from measurements before each tracer was added to the rock mass from the attenuation factors derived after each tracer was added. The alterant tomographs were compared with other evidence of water movement in the rock: borescope logs of fractures, and post experiment cores used to locate the dye tracer on the fractured surfaces. These comparisons indicate that alterant tomography is suitable for mapping water flow through fractures and that it may be useful in inferring which of the fractures are hydrologically connected in the image plane. The technique appears to be sensitive enough to delineate flow through a single fracture and to define fractures with a spatial resolution of about 10 cm on an imaging scale of a few meters. 9 refs., 3 figs.

5545 **Method and apparatus for in-cell vacuuming of radiologically contaminated materials.** Spadaro, P.R.; Smith, J.E.; Speer, E.L.; Cecconi, A.L. (to Dept. of Energy, Washington, DC). US Patent 4,695,299. 22 Sep 1987. Filed date 21 Feb 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a vacuum system having a vacuum source for collecting radiologically contaminated material for disposal, comprising: an inlet nozzle for collecting the material; a cyclone separator connected to the inlet nozzle to receive the material. The cyclone separator has a material discharge and an air flow discharge; a product container positioned at the material discharge for receiving material discharged from the cyclone separator. The product container is transparent for allowing observation of a level of material collected; a first prefilter downstream of the air flow discharge for filtering air from the air flow discharge; a second prefilter connected between the vacuum source and the first prefilter for filtering air from the first prefilter. The second prefilter has means for visually observing the air flow in the second prefilter; means for monitoring a pressure drop across the first prefilter; and means for supporting the product container against the material discharge during operation and for facilitating removal of the product container from the material discharge for disposal of the material.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 5437, 5438, 5439, 5455, 5456, 5457, 5458, 5460, 5461, 5462, 5463, 5465, 5466, 5467, 5468, 5469, 5470, 5472, 5473, 5475, 5477, 5478, 5482, 5483, 5486, 5489, 5493, 5495, 5497, 5500, 5503, 5504, 5510, 5511, 5513, 5515, 5516, 5517, 5518, 5521, 5522, 5523, 5524, 5525, 5526, 5527, 5529, 5530, 5531, 5532, 5534, 5535, 5536, 5537, 5539, 5540, 5541, 5544, 5550, 5559, 5754, 5995, 6241, 6500

0540 Health And Safety

REFER ALSO TO CITATION(S) 5460, 5468, 5473, 5486, 6220, 6536, 6567, 6569

5546 (ANL/EES-TM—291, pp 11-20) **The Y-12 criticality accident.** Auxier, J. (Applied Science Lab., Inc., Oak Ridge, TN). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

This report describes the 1958 nuclear accident at Y-12 and the problems experienced by health physics and medical experts in determining the magnitude of the exposures to nearby personnel. Also included are descriptions of makeshift remote handling equipment used to decontaminate areas of the plant. 5 figs., 2 tabs. (TEM)

5547 (EUR—10006) **Safety and reliability in Europe. Proceedings.** Colombo, A.G. (ed.). (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1985. 576p. (CONF-8410459—). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88700592/JAW.

From Pre-launching meeting of the European Safety and Reliability Association (ESRA); Ispra, Italy (9 Oct 1984).

This volume contains the papers presented at the ESRA Pre-Launching Meeting. The meeting was attended by about eighty European reliability and safety experts from industry, research organizations and universities. This meeting was dealing with the following subjects: the historical perspective of safety and reliability in Europe and to the aims of ESRA. Status and Trends in Research and Development; Codes, Standards and Regulations; Academic and Technical Training. National and international Organizations. Twenty six papers have been analyzed and abstracted for inclusion in the data base.

5548 (GAO/RCED—87-93) **Nuclear materials: Alternatives for relocating Rocky Flats Plant's plutonium operations.** (General Accounting Office, Washington, DC (USA)). 1987. 55p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Major operational problems in a plutonium-processing building at the Department of Energy's Rocky Flats Plant near Denver, Colorado, have existed since the building became operational in 1981. High estimated costs have been associated with repairing the building and potential risks have been associated with the plant's proximity to a major metropolitan center. Four alternatives have been identified for relocating plutonium processing that would cost between about $200 million and $600 million. These alternatives would require between 4 and 10 years to implement, including design, construction and/or alterations and startup. This is in comparison to an estimated cost of about $300 million to repair building 371 at the Rocky Flats Plant and an implementation period of 8 years. The alternative that addresses fabrication operations, the major contributor to safety and health risks at Rocky Flats is to relocate all Rocky Flats plutonium operations. This would cost over $4 billion and take as long as 24 years. On a cost basis alone, this alternative does not appear justified.

5549 (KY/B—264) **An interim report to the manager of the Paducah Gaseous Diffusion Plant from the Paducah Environmental Advisory Committee.** Jackson, G.D. (Paducah Gaseous Diffusion Plant, KY (USA)). Oct 1987. Contract AC05-84OU21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002172/JAW.

The Paducah Environmental Advisory Committee was formed as: (1) an outgrowth of other Environmental Advisory Committees already in existence at Oak Ridge and other Martin Marietta Energy Systems plants; (2) a result of public concern following significant nuclear incidents at Bhopal and Chernobyl; (3) a result of the new direction and commitment of the management of the Paducah Gaseous Diffusion Plant following contract acquisition by Martin Marietta Energy Systems; and (4) a means of reducing and/or preventing local and/or public concern regarding the activities of and potential risks created by PGDP. This report discusses the following issues and concerns of the Committee arrived at through a series of meetings: (1) groundwater monitoring; (2) long-range tails storage; C-404, scrap yrads, and PCB and TCE cleanup; nuclear criticality plan and alarm systems; documentation of historical data regarding hazardous waste burial grounds; dosimeter badges; and asbestos handling and removal. (ACR)

5550 (MLM—3462(OP)) **Health physics procedures in the removal of contaminated external ducts in a populated area.** Draper, D.G.; Davis, W.P.; Garner, J.M.; Geichman, J.R. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). Oct 1987. Contract AC04-76DP00053. 11p. (CONF-871018—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002317/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Special Metallurgical (SM) Building at the facility located in Miamisburg, Ohio, is currently in the decommissioning process. An early task was the removal of external ductwork that was highly contaminated with plutonium-238. Approximately 450 linear feet of duct that averaged three feet in diameter were included in the project. One duct, approximately 150 feet in length, connected an external filter bank with a stack plenum and was moderately contaminated. This duct was removed first so that contamination control techniques could be developed for use later in the removal of the second duct which was highly contaminated. Because SM Building is located approximately 100 meters from the fenceline procedures were required which offered a high degree of assurance

that airborne release of contamination would be strictly controlled. Special fixation techniques, decontamination methods, and other procedures were employed in the removal of the ductwork and subsequent removal and replacement of the roof. 5 refs., 2 figs., 2 tabs.

5551 **(NUREG—0762-Rev.1) Standard format and content for emergency plans for fuel-cycle and materials facilities: Draft report for comment.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Industrial and Medical Nuclear Safety). Nov 1987. 33p. NTIS, PC A03/MF A01 - GPO. Order Number TI88900148/JAW.

This report is issued as guidance to those fuel-cycle and major materials licensees who are required by the NRC to prepare and submit an emergency plan. This Standard Format has been prepared to help ensure uniformity and completeness in the preparation of those plans.

5552 **(SSI—86-30) Research plan - Fiscal year 1986/1987.** Baeverstam, U. (National Inst. of Radiation Protection, Stockholm (Sweden)). 1 Dec 1986. 31p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750364/JAW.

This is an estimate of external research efforts and it includes also a plan for the coming 5 years. The budget is 3.7 MSEK for non-nuclear power research and 6. 351 MSEK for research in connection with nuclear power. The areas which are dealt with are as follows: ionizing radiation, isotopes in medicine, natural radiation, radiofrequencies, ultraviolet and laser radiation and ultrasound. In the nuclear power side the research will cover safety, radioactive waste, ecology, migration and accidents. (G.B.).

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 5461, 5471, 5715, 5770, 5784, 5784, 6569

5553 **(K/ITP—156/P1) Nuclear material safeguards for enrichment plants: Part 1, Uranium enrichment: General principles and processes: Safeguards training course.** (Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs Div.). Oct 1987. Contract AC05-84OT21400. 235p. (ISPO—284/P1; CONF-871174—Pt.1). NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88002333/JAW.

From IAEA training course on safeguards relevant principles of uranium enrichment; Vienna, Austria (9 Nov 1987).

This 5-day training course on nuclear material safeguards for uranium enrichment plants has been developed to train IAEA professionals who are responsible for safeguards uranium enrichment facilities on the safeguards relevant principles of enrichment technology, particularly as related to centrifuge enrichment plants. The main objective is to provide the course participants with the necessary skills to perform their inspection activities at enrichment plants. A variety of enrichment technologies are characterized and compared followed by a review of basic cascade and gas centrifuge theory. To focus on gas centrifuge technology, the major components and systems of a gas centrifuge enrichment plant including their function in routine LEU production are identified. The objectives of IAEA safeguards at a gas centrifuge enrichment plant, specifically as agreed to in the Hexapartite Safeguards Project, are then described. Discussions then focus on potential diversion scenarios at a centrifuge enrichment facility and applicable safeguards inspection activities for detecting these scenarios. This volume contains discussions on general principles of uranium enrichment and a review of uranium enrichment technologies.

5554 **(K/ITP—156/P2) Nuclear material safeguards for enrichment plants: Part 2, Cascade and centrifuge separation theory; uranium hexafluoride: Safeguards training course.** (Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs Div.). Oct 1987. Contract AC05-84OT21400. 316p. (ISPO—284/P2; CONF-871174—Pt.2). NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88002258/JAW.

From IAEA training course on safeguards relevant principles of uranium enrichment; Vienna, Austria (9 Nov 1987).

This 5-day training course on nuclear material safeguards for uranium enrichment plants has been developed to train IAEA professionals who are responsible for safeguarding uranium enrichment facilities on the safeguards relevant principles of enrichment technology, particularly as related to centrifuge enrichment plants. This volume contains discussions on basic separation and cascade theory, uranium hexafluoride, and gas centrigude separation theory.

5555 **(K/ITP—156/P3) Nuclear material safeguards for enrichment plants: Part 3, Gas Centrifuge Enrichment Plant: Description, material control and accountability procedures, and IAEA safeguards: Safeguards training course.** (Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs Div.). Oct 1987. Contract AC05-84OT21400. 282p. (ISPO—284/P3; CONF-871174—Pt.3). NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88002332/JAW.

From IAEA training course on safeguards relevant principles of uranium enrichment; Vienna, Austria (9 Nov 1987).

This 5-day training course on nuclear material safeguards for uranium enrichment plants has been developed to train IAEA professionals who are responsible for safeguarding uranium enrichment facilities on the safeguards relevant principles of enrichment technology, particularly as related to centrifuge enrichment plants. This volume contains discussions on IAEA safeguards at a gas centrifuge enrichment plant, centrifuge facility material control and accountability procedures, and a description of a centrifuge enrichment plant.

5556 **(K/ITP—156/P4) Nuclear material safeguards for enrichment plants: Part 4, Gas Centrifuge Enrichment Plant: Diversion scenarios and IAEA safeguards activities: Safeguards training course.** (Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs Div.). Oct 1987. Contract AC05-84OT21400. 210p. (ISPO—284/P4; CONF-871174—Pt.4). NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88002334/JAW.

From IAEA training course on safeguards relevant principles of uranium enrichment; Vienna, Austria (9 Nov 1987).

This 5-day training course on nuclear material safeguards for uranium enrichment plants has been developed to train IAEA professionals who are responsible for safeguarding uranium enrichment facilties on the safeguards relevant principles of enrichment technology, particularly as related to centrifuge enrichment plants. This volume contains discussions of diversions of declared material at a centrifuge plant, centrifuge facility material balance verification activities, enriching beyond declared levels in a centrifuge facility, safeguards inspection techniques that may be used inside cascade areas, and demonstration of the enrichment verification measurement technique for cascade header pipes.

5557 **(LA—11073-MS) Computer simulation of the L/sub III/-edge densitometer.** Langner, D. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001944/JAW.

Since the L/sub III/-edge densitometer was first fielded in 1977, it has displayed a 1 to 1.5% nonlinear deviation from its theoretical linear calibration response. In an effort to explain this nonlinear deviation, this study used a simple, closed-form computer simulation to examine the effects of several variables on the densitometer's measurement of uranium and plutonium in solution. The results of this simulation suggest that the variables that contribute to this nonlinearity include the effects of small-angle scattering and the detection system resolution function. The simulation also examined the effects of matrix contaminants, the shape of the incoming beam, the uranium-to-plutonium ratio for mixed solutions, and the data-reduction technique. All of these variables were found to have some effect on the assay results, although these were generally small. The calculations demonstrate that using a new edge-extrapolation data-reduction technique reduces the instrument's sensitivity to many of these variables.

5558 **(LA-UR—87-3501) Spent-fuel verification with the Los Alamos fork detector.** Rinard, P.M.; Bosler, G.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871110—1). NTIS, PC A02. Order Number DE88001790/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

The Los Alamos fork detector for the verification of spent-fuel assemblies has generated precise, reproducible data. The data analyses have now evolved to the point of placing tight restrictions on a diverter's actions.

5559 **(MLM—3461(OP)) An overview of plutonium-238 decontamination and decommissioning (D & D) projects at Mound.** Bond, W.H.; Davis, W.P.; Draper, D.G.; Geichman, J.R.; Harris, J.C.; Jaeger, R.R.; Sohn, R.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 12p. (CONF-871018—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002319/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Mound is currently decontaminating for restricted reuse and/or decommissioning for conditional release four major plutonium-238 contaminated facilities that contained 1700 linear feet of gloveboxes and associated equipment and services. Several thousand linear feet of external underground piping, associated tanks, and contaminated soil are being removed. Two of the facilities contain ongoing operations and will be reused for both radioactive and nonradioactive programs. Two others will be completely demolished and the land area will become available for future DOE building sites. An overview of the successful techniques and equipment used in the decontamination and decommissioning of individual pieces of equipment, gloveboxes, services, laboratories, sections of buildings, entire buildings, and external underground piping, tanks, and soil in a highly populated residential area is described and pictorially presented.

5560 **(SAND—87-1980) Experiences in teleoperation of land vehicles.** McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001695/JAW.

Teleoperation of land vehicles allows the removal of the operator from the vehicle to a remote location. This can greatly increase operator safety and comfort in applications such as security patrol or military combat. The cost includes system complexity and reduced system performance. All feedback on vehicle performance and on environmental conditions must pass through sensors, a communications channel, and displays. In particular, this requires vision to be transmitted by closed circuit television (CCTV), with a consequent degradation of information content. Vehicular teleoperation, as a result, places severe demands on the operator. Teleoperated land vehicles have been built and tested by many organizations including Sandia National Laboratories (SNL). The SNL fleet presently includes eight vehicles of varying capability. These vehicles have been operated using different types of controls, displays, and visual systems. Experimentation studying the effects of vision-system characteristics on off-road, remote driving has been performed for conditions of fixed camera versus steering coupled camera and color versus black and white video display. Additionally, much experience has been gained through system demonstrations and hardware development trials. This paper discusses the preliminary experimental findings and the results of the accumulated operational experience.

5561 **(SAND—87-2611C) Item and personnel tracking.** Waddoups, I.G. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 5p. (CONF-871110—3). NTIS, PC A02. Order Number DE88002112/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

This paper discusses advantages and disadvantages of item and personnel tracking. Demonstration systems to evaluate tracking are discussed and the results of demonstration tests presented.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 5442, 5443, 5444, 5445, 5453, 5492, 5494, 5496, 5551, 5854

5562 **(GAO/AFMD—86-19) Financial audit: DOE Uranium Enrichment Activity financial statements - September 30, 1984.** (General Accounting Office, Washington, DC (USA)). 1986. 31p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

In GAO's opinion the Department of Energy did not comply with the terms and provisions of laws and regulations for the financial transactions tested. Specifically, DOE did not comply with the Atomic Energy Act of 1954, as amended, requiring the Uranium Enrichment Activity to recover the cost of its operations when setting prices to be charged to its customers. Also, DOE's actions concerning its new utility services contract were not in compliance with applicable statutory principles. UEA did not amend its pricing criteria as required by the Atomic Energy Act, as amended. Consequently UEA did not comply with the 45-day notification to the appropriate congressional oversight committees as also required by the act.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

REFER ALSO TO CITATION(S) 6369

5563 **(NIIAR—10-656) Comparative investigations of sealed radionuclide neutron sources of INK-3 and CVN-5 type.** Berkutov, V.L.; Vladimirova, N.A.; Davydov, E.F.; Karasev, V.I.; Karelin, E.A. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700568/JAW.

Results of comparative investigation into main indications of quality and technical level of sealed radionuclide neutron sources of IMK-3 type (the USSR) and CVN-5 type (britain company "Amersham") are given. The comparative analysis was performed according to the OST 9510017-83 technique using calculating and expert methods. A generalized complex indicator for the INK-3 type source exceeds a unit with respect to the CVN-5 source taken as a base version. This permits to conclude that native sources are inferior to the best analogous foreign sources with respect to the quality and technical level. 8 refs.; 3 tabs.

5564 **(NIIAR—18-699) Determination of the probability of α-particle escape from radioactive sources of a simple geometrical configuration.** Stupin, V.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700569/JAW.

Based on the notion of geometric probability the probability of α-particle escape from the sources of the cylindrical and spherical shape as well as from the layer of α-emitting substance of the infinite extent has been calculated. Formulae are obtained describing the relation between the probability of α-particle escape from the source and source dimensions. 4 refs.; 10 figs.

5565 **(NIIAR—23-669) Automatic data processing of γ-scanning of extended cores for californium-252 neutron sources.** Demchenko, N.F.; Pevtsov, V.V.; Skornyakov, S.I. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700570/JAW.

Automatic system for γ-scanning of /sup 252/Cf neutron source extended cores is described. It enables the experimental information to be acquired, to be transmitted to a micro-computer

and to be proposed on the basis of "Module" and "Scanning" programs. The histogram of the activity distribution along the core length is presented and a pattern of the histogram processing readout is demonstrated. 3 refs.; 4 figs.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 5597, 5598, 5611

0808 Properties

5566 **(BMFT-FB-T—86-206) Use of non-porous metal membranes for the separation of hydrogen from gas mixtures. Final report.** Weirich, W.; Oertel, M.; Winkelmann, U. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Reaktortechnik). Dec 1986. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750987/JAW.

The use of non-porous metal membranes enables the separation of hydrogen from other gases in one step. The thus obtained hydrogen is highly purified. Today these membranes are made of palladium alloys. The high cost of these materials allows only a limited industrial use of this separation method. With a view to large-scale employment, the Lehrstuhl fuer Reaktortechnik of the RWTH-Aachen has developed membranes based on cheaper materials. Membranes were manufactured from niobium, tantalum and vanadium, each coated with a palladium alloy, and from a TiNi-alloy. The influence of both the production procedure and the other gases (CH/sub 4/, CO/sub 2/, CO, N/sub 2/) on the hydrogen permeation was investigated at temperatures between 300degC and 750degC and at hydrogen pressures ranging from 0.1 to 5 bars. Under these conditions niobium and tantalum tend towards hydrogen-embrittlement, vanadium membranes are mechanically stable above 340degC and membranes made of TiNi are not destroyed, if they first undergo a suitable annealing pretreatment. The permeation rates of Ni-coated TiNi-membranes at 750degC are lower by a factor of ten than those of palladium-membranes. Nitrogen causes the greatest reduction of hydrogen permeation (24%) through coated vanadium-membranes. Depending on experimental conditions, permeation rates which are 2.9 to 4.6 times higher than those of palladium-membranes of the same dimensions are possible. With 18 refs., 6 tabs., 24 figs..

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 5377

5567 **(DOE/PC/80015—8) Fischer-Tropsch slurry phase process variations to understand wax formations: Quarterly report, July 1, 1987-September 30, 1987.** Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract AC22-85PC80015. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001855/JAW.

The performance of a sample of Ruhrchemie catalyst is compared in an approximate fashion to that of a PETC precipitated Fe catalyst, Mobil low wax and high wax catalysts, Sasol fixed bed catalyst and C-73 fused magnetite catalyst. Results indicate that the Ruhrchemie catalyst has about one-third the activity of the other catalysts, and is much less active for the water gas shift. It shows a double α distribution, breaking at about C_7, $\alpha_1 = 0.68$ and $\alpha_2 = 0.85$. C/sub 12+/ formation was comparable to that from the PETC catalyst and the Mobil low wax catalyst, higher than that from C-73 and lower than that produced by Mobil high wax catalyst and in the Sasol fixed bed reactors. The effect of adding CO_2 during synthesis on a C-73 magnetite catalyst has been studied. CO_2 forms H_2O by the reverse water gas shift and the kinetics observed can be attributed to the H_2O formation. The effects on product selectivity also seem to be mostly attributable to the H_2O formed. 6 figs., 3 tabs.

5568 **(DOE/PC/90008—T1) Heat transfer investigations in a slurry bubble column: Quarterly report for the period July-September 1987.** Saxena, S.C.; Vadivel, R.; Zhou, S. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). 1987. Contract AC22-86PC90008. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001445/JAW.

This report discusses fabrication and installation of the 10.8 cm internal diameter Plexiglas slurry bubble column as well as of the associated gas and slurry flow loops. The heat transfer probes together with its power supply system, and temperature measurement circuit as well as details of this facility and the results of some of the preliminary test runs completed to-date are described in this report. Substantial design and partial fabrication of the 30.5 cm diameter pyrex glass slurry bubble column has been completed, and many components required to complete the remaining parts of the system are under order. Review and collection of the literature dealing with the hydrodynamics and heat transfer in two- and three-phase slurry bubble columns has been initiated.

5569 **(Juel-Spez—392) Energy alcohols. Production and application of a synthetic liquid energy carrier.** Decken, C.B. von der; Doetsch, H.; Hoehlein, B.; Fedders, H.; Riensche, E.; Broeckerhoff, P.; Pischinger, F.; Hilger, U.; Barnert, H.; Niessen, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Mar 1987. 124p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750994/JAW.

On the basis of the well-known process of methanol synthesis, the programme highlights research objects which aim at improving the profitability and efficiency factor of the alcohol production. As regards the synthesis of alcohol mixtures, two tendencies begin to show which differ as to the catalyst used and the respective process conditions. The optimization of the synthesis process concerns both the composition of the liquid product and the composition of the synthesis gas available. Crude synthesis gases of differing quality can be produced on the basis of any carbonaceous raw material. All gas compositions can be simulated by means of a modified natural gas reforming plant (EVA I). The examination of the environmental behaviour of energy alcohols includes engine bench tests as well as experiments with different domestic burners. In this context, our main interest is focused on reaching a combustion with a low degree of emission (particles, NO/sub x/, hydrocarbons), on finding the optimum composition of energy alcohols, and on developing technical instructions as to transportation, storage, and application. The process calculations aim at determining the flow of energy and mass and at retaining and, if possible, utilizing the residues. The results of these calculations will provide the parameters for the system analysis.

5570 **(N—87-27338) Methane flux from the Central Amazonian Floodplain. Final report.** Bartlett, K.B.; Crill, P.M.; Sebacher, D.I.; Harriss, R.C.; Wilson, J.O.; Melack, J.M. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Aug 1987. 51p. (NASA-TM—89296; NAS—1.15:89296). NTIS, PC A04/MF A01.

A total of 186 methane measurements from the three primary Amazon floodplain environments of open water lakes, flood forests, and floating grass mats were made over the period 18 July through 2 September 1985. These data indicate that emissions were lowest over open water lakes. Flux from flooded forests and grass mats was significantly higher. At least three transport processes contribute to tropospheric emissions: ebullition from sediments, diffusion along the concentration gradient from sediment to overlaying water to air, and transport through the roots and stems of aquatic plants. Measurements indicate that the first two of these processes are most significant. It was estimated that on the average bubbling makes up 49% of the flux from open water, 54% of that from flooded forests, and 64% of that from floating mats. If the measurements were applied to the entire Amazonian floodplain, it is

calculated that the region could supply up to 12% of the estimated global natural sources of methane.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 5577

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 5400, 6417

5571 (SI—3-1987) Wood-ashes from chip fueled heating plants. Chemical composition, possibilities of application. Kofman, P.D. (Skovteknisk Inst., Copenhagen (Denmark)). 1987. 20p. (In Danish). Skovteknisk Institut, DK-1875 Frederiksberg C.

Samples of ashes from sixteen wood fueled heating plants were taken for mineral content determination. The size of the plants varied from an ordinary domestic stove to a major district heating plant of 10 MW. Nine of the sixteen plants used fuel chips of conifer, three hardwood chips, two bark or bark/conifer chips, one chips and straw, and one hardwood billets and advertising matters. At five heating plants it was possible to take samples of both fly ash and bottom ash. The samples were analysed separately, and subsequently a weighted average of bottom ash and fly ash was calculated. The analyses proved the ashes to be alkaline, the pH value being >12, and to contain a high proportion of insoluble material, mainly sand. The average content of insoluble material was 43,6% for ashes of conifer chips. Complete combustion was not achieved in all cases. The average content of uncombusted material was 16,8%. The contents of macro- and micro-nutrients, trace elements and heavy metals were determined. High contents of calcium, potassium and magnesium were found, somewhat less phosphorus. The trace elements copper, iron, manganese and sodium were well represented too, and contrary to what was expected the ashes also contained the heavy metals zinc, lead, cadmium and cobalt. The average mineral contents in oven-dry ashes of conifer chips were 1,4% phosphorus, 4,6% potassium, 13% calcium, and 1,7% manganese. However, the mineral contents varied greatly. The analyses further showed these ashes to contain averagely 800 ppm sinc, 100 ppm lead, 15 ppm cobalt, and 8 ppm cadmium. The above results indicate that ashes from chip fueled heating plants may safely be used as a fertilizer in the forest where no risk of heavy metals being introduced into the food chain is present. (LN). EFP-85; 19 refs.

13 HYDRO ENERGY

1305 Economics And Management

REFER ALSO TO CITATION(S) 5416

1306 Environmental Aspects

5572 (EPRI-AP—5492) Hydraulic model evaluation of the Eicher passive pressure screen fish bypass system: Final report. Wert, M.A. (Eicher Associates, Inc., Portland, OR (USA)). Oct 1987. 129p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920078/JAW.

A hydraulic model of a passive pressure screen fish bypass system was evaluated at the University of Washington Harris Hydraulics Laboratory, Seattle, during 1984 and 1985. Stainless steel wedgewire screen inclined at 10.5, 16.5 or 30 degrees to horizontal, was tested in a Plexiglas conduit. Velocity profiles were measured by pitot tube traverses. Dye tracers were also released to visually track the streamline patterns. Fish were monitored by video camera and recorder as they passed through the pressurized model. The screen angles, water velocities and screen types were varied. Scale loss was evaluated for smolted fish contacting the screen. Species tested included rainbow trout (Salmo gairdneri) and smolts of coho salmon (Oncorhynchus kisutch), chinook salmon (O. tshawystcha) and steelhead trout (S. gairdneri). Scale loss did not occur to coho, chinook or steelhead smolts which contacted the screen. No delayed mortality was observed within 72 hours after testing. All fish were successfully passed when velocities through the model were maintained at greater than 5 feet (1.5 m) per second. Small fish (fry size) passed through the model more swiftly than larger ones. Rainbow trout were used for impingement tests over a range of test section velocities from 3.0 feet (0.9 m) to 10 feet (3 m) per second. Impingement was predictably produced or avoided by manipulation of velocities, and was most prevalent at test section velocities under 4 feet (1.2 m) per second. Variations in the velocity vector perpendicular to the screen did not affect fish passage over the range tested of 0.4 to 3.0 feet (0.1 to 0.9 m) per second.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 5925

5573 (EFN—24) Monitoring long-term energy technology. An evaluation. (Energiforskningsnaemnden, Stockholm (Sweden)). Dec 1986. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750411/JAW.

The Swedish Long-Term Energy Technology Programme (LET), which started in 1975 and has been managed by Efn since 1983, was evaluated by external experts. The present report is the outcome of the second global part of the evaluation exercise, drawing from evaluations of the individual programme constituents as well as from visits to the contracting firms and laboratories. The basic goal of the LET programme has been to build up competence and to follow international developments with a view towards their application to the Swedish energy system. The programme has been continuously adapted to the development of knowledge, the international energy situation and the Swedish energy policy. Accordingly, at its beginning, the programme covered a broad range of subjects and then narrowed down to study in depth a more limited number of long-term technologies. Some of the technologies taken out the programme had reached the prototype stage and were transferred to other programmes, others were abandoned because of poor overall prospects. (authors).

1401 Resources And Availability

5574 (DOE/CH/10200—3) Satellite techniques of solar resource assessment for focusing and non-focusing solar collector systems: Final report. Justus, C.G. (Georgia Inst. of Tech., Atlanta (USA). School of Geophysical Sciences). Sep 1987. Contract FG02-84CH10200. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001657/JAW.

The goal of this project is to produce an atlas of the solar energy resources of Saudi Arabia. This paper presents results of comparisons between direct and GOES satellite measurements of solar radiation in Saudi Arabia. Measurements made on the ground are plotted against estimates made from the satellite data. 4 refs., 16 figs. (JDH)

5575 Importance of correct albedo determination for adequately modeling energy received by tilted surfaces. Ineichen, P.; Perez, R.; Seals, R. (Univ. of Geneva, Switzerland). *Solar Energy;* **39**: No. 4, 301-305(1987).

The aim of this work is to demonstrate the importance of correct estimation of the radiation reflected by the ground and perceived on a tilted surface. A good evaluation of the reflected radiation is an essential complement to any diffuse radiation and daylight transposition model.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 5920

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 5885, 6051, 6079, 6089, 6203, 6434, 6487

5576 (CONF-8706194—2) Energy crop research advances the fundamentals of forest biology. Layton, P.A.; Wright, L.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014573/JAW.

From Southern forest biomass working group; Biloxi, MS, USA (8 Jun 1987).

The Short Rotation Woody Crops Program sponsors research on tree and crop physiology, genetic improvement, and biotechnology. Genetic improvement of cottonwoods (Populus spp.) has produced clones with average yields of 25 dry Mg/ha/y. Physiological research on cottonwoods and their hybrids have shown that the hybrids were intermediate to their parental types in many characteristics. The goal of this research is to identify individual traits contributing to enhanced growth and to genetically improve these traits. The biotechnological goal is to develop herbicide and pest-resistant hybrid poplars. Models have been developed to describe both individual and stand growth in an effort to determine productivity and identify tree ideotypes that grow well in short-rotation intensive culture systems.

5577 (CONF-8710145—1) Hydrolysis of cellulose by purified cellulase components: Synergistic effects. Woodward, J.; Lee, N.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014954/JAW.

From Biochemical conversion program annual review meeting; Golden, CO, USA (13 Oct 1987).

The hydrolysis of cellulose by purified cellulase components is reported. The adsorption of purified cellobiohydrolases (CBH I and II) and endoglucanases (EG I and II) from Trichoderma reesei strain L27 to microcrystalline cellulose (Avicel) has been studied. Scatchard analysis of the adsorption data gave the maximum amount of each component that bound to Avicel at saturation. Hydrolysis of Avicel was thus carried out by saturating and non-saturating (50% saturation) concentrations of cellulase components alone and in combination with each other, and it was found that the greatest amount of synergism between them was observed when Avicel was incubated with non-saturating concentrations of enzyme. Synergism was observed between CBH I and CBH II, as well as between EG I and CBH I; however, inhibition of hydrolysis occurred using a combination of EG I and EG II. Synergism between cellulase components may be significant during cellulose hydrolysis only when non-saturating enzyme concentrations are used. 4 refs., 3 figs.

5578 (DOE/BP/17609—T1) Harvesting overstocked stands of small diameter trees: Stem densities of trees from overstocked mixed conifer stands of western hemlock, Douglas-fir and western redcedar. Pong, W.Y.; Waddell, D.R. (Forest Service, Portland, OR (USA). Pacific Northwest Forest and Range Experiment Station). 15 Mar 1985. Contract AI79-84BP17609. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87011715/JAW.

Stem density (wood and bark combined) on overstocked mixed conifer stands of Douglas-fir, westernn hemlock and wester redcedar was studied in the Quilcene Ranger District, Olympic National Forest in the State of Washington. This study was to better understand the economics, technology, and impacts of harvesting overstocked stands of small diameter timber. Previous studies on the density of stem wood that generally have been derived from trees growing in stands of normal stocking levels. Stem densities, an essential parameter in the determination of stem biomass, has not previously been investigated for trees growing in overstocked conditions. Predictive estimators of density based on data derived from studies of normally stocked stands can not be applied to trees growing in an overstocked condition with reliability. Thus the need to specifically examine stem densities in trees grown under these adverse conditions exists. 3 tabs.

5579 (DOE/ER/60342—T1) The Carolina conference on marine biotechnology: Final technical report. Frankenberg, D. (North Carolina Univ., Chapel Hill (USA)). 1985. Contract FG05-85ER60342. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002140/JAW.

This report summarizes proceedings of a Carolina Conference on Marine Biotechnology held March 24-26, 1985, at the University of North Carolina at Chapel Hill. This report consists of the responders' summary of each topic discussed. The topics presented were General Prospects for Marine Biotechnology, Bioactive Substances from Marine Organisms, Fundamental Processes in Marine Organisms as Guides for Biotechnology Development, Genetic Manipulation of Potential Use to Mariculture, Organisms Interactions with Marine Surfaces: Marine Glues, and Biomolecular Engineering Materials Applications.

5580 (DOE/EV/00637—16) Development of innovative techniques and principles that may be used as models to improve plant performance: Technical progress report, February 1, 1987 to January 31, 1988. Hanna, W.W.; Burton, G.W. (Georgia Univ., Athens (USA). Research Foundation). Sep 1987. Contract AS09-76EV00637. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001725/JAW.

Plant breeders can develop such plants as they have in the past but they will have less time in which to do it. A method for storing pearl millet pollen has been developed which makes germplasm available for crossing on an as needed basis; viability has been maintained in storage for over three years. New cytoplasms have been transferred from wild species to cultivated pearl millet. One cytoplasm conditions excellent cytoplasmic male sterility and produces no fertile revertants. Other cytoplasms appear to affect seed weight and dry matter yields. Techniques for transferring and using genes from the wild grassy relatives in the cultivated species have resulted in the transfer and release of two pearl millet inbreds and one F_1 hybrid with dominant genes for immunity to both rust and Piricularia leaf spot. Significant progress is being made in developing an obligate apomictic pearl millet.

5581 (EUR—10148) Socioeconomic studies of the utilization of agricultural wastes in pyrolysis conversion in Apulia. Bartolelli, M. (Bari Univ. (Italy)). 1985. 172p. (In Italian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88900169/JAW.

An assessment of the characteristics and energy needs of farms, agro-industries and forestry organizations is provided for the Apulia (Puglia) region of Italy. Data on biomass resources of this region on the potential of energy crops and on harvesting costs are given. The socio-economic benefits which would derive from a wide regional penetration of the biomass pyrolytic conversion technology are evaluated.

5582 (N—87-27322) Theoretical study of photovoltaic converters. Progress report, 16 May 1986-1 January 1987. Heinbockel, J.H. (Old Dominion Univ., Norfolk, VA (USA)). Jan 1987. 11p. (NASA-CR—180635; NAS—1.26:180635). NTIS, PC A02/MF A01.

Mathematical models for the photovoltaic conversion of laser power were developed. These models simulate the operation of planar and vertical junction photovoltaic converters and are described in detail.

5583 (N—87-27323) Theoretical study of photovoltaic converters. Final report, period ending 16 May 1987. Heinbockel, J.H. (Old Dominion Univ., Norfolk, VA (USA)). May 1987. 20p. (NASA-CR—180956; NAS—1.26:180956). NTIS, PC A02/MF A01.

The final phase of research was performed in the model simulation for the solar simulator pumped atomic iodine laser. The geometry for the steady state laser operation with axial lasant flow is illustrated. The chemical kinetics for this laser are described.

5584 (N—87-27541) **V-grooved AlGaAs/GaAs passivated PN junction.** Bailey, S.G.; Leon, R.P.; Arrison, A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1987. 12p. (NASA-TM—100138; E—3688; NAS—1.15:100138; CONF-870528—). NTIS, PC A02/MF A01.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A passivated, V-grooved GaAs solar cell offers important advantages in terms of improved optical coupling, higher short circuit current, and increased tolerance to particle radiation when compared to the planar cell configuration. An AlGaAs epilayer has been deposited on a p-type GaAs epilayer grown on an n-type V-grooved GaAs surface using MOCVD. A wet chemical etching process was used to produce a V-pattern with a 7.0 micron periodicity. Reflectivity measurements substantiate the expected decrease in solar reflectance. Scanning electron microscopy techniques were used to confirm the presence of the AlGaAs layer and verify the existence of a pn junction.

5585 (N—87-28178) **Mathematical modeling of a photovoltaic-laser energy converter for iodine laser radiation.** Walker, G.H.; Heinbockel, J.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1987. 15p. (NASA-TM—100482; NAS—1.15:100482). NTIS, PC A02/MF A01.

Space-based laser power systems will require converters to change laser radiation into electricity. Vertical junction photovoltaic converters are promising devices for this use. A promising laser for the laser power station is the t-C_4F_9I laser which emits radiation at a wavelength of 1.315 microns. This paper describes the results of mathematical modeling of a photovoltaic-laser energy converter for use with this laser. The material for this photovoltaic converter is Ga(53)In(47)As which has a bandgap energy of 0.94 eV, slightly below the energy of the laser photons (0.943 eV). Results of a study optimizing the converter parameters are presented. Calculated efficiency for a 1000 vertical junction converter is 42.5 percent at a power density of 1 x 10 to the 3d power w/sq cm.

5586 (SERI/CP—233-2959, pp 3-8) **Studies in solar photochemistry.** Guillet, J.E. (Univ. of Toronto, Ontario). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

A new inexpensive method for carrying out commercial scale organic photochemical syntheses has been developed using sunlight as the photon source. In the examples of this technology presented here, organic starting materials are absorbed into transparent beads of crosslinked polymer that serve as transportable, reusable mini-reactors. These beads float readily on water and can be exposed to natural sunlight on the surface of a pond. After exposure, the beads are collected, washed with water and dried in air. The chemical products and unreacted starting materials are then removed by selective extraction with suitable solvent mixtures, after which the beads can be recycled through the process. The laboratory scale experiments reported here demonstrate the viability of the process. Calculations are presented to show the production scales attainable in a commercial solar photochemical plant. Examples of different possible commercial syntheses are given, including Rose oxide and Vitamin D.

5587 (SERI/CP—233-2959, pp 9-14) **Energy conversion processes based on molecular excited states.** Meyer, T.J. (Univ. of North Carolina, Chapel Hill). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The major thrust of the DOE-supported research efforts remains the use of molecular excited states in energy conversion processes. The authors have made significant progress in four distinct areas: 1) photochemistry and photophysics of MLCT excited states; 2) medium effects on excited state properties; 3) photoeffects in thin polymeric films; and 4) photochemistry of metal-metal bonds.

5588 (SERI/CP—233-2959, pp 15-19) **Oxidative quenching of low-lying excited states in porphyrins and phthalocyanines by electron acceptors.** Stillman, M.J.; Nyokong, T.; Gasyna, Z.; Browett, W.R. (Univ. of Western Ontario, London). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Porphyrins and phthalocyanines can act as highly-efficient electron donor molecules in linked donor-acceptor complexes that may be utilized in molecular solar energy conversion devices. The initial work of J.R. Bolton, which was aimed at maximizing the photochemical yield of charge-separated species based on a linked porphyrin-quinone (PQ) complex, has been expanded into a collaborative project at the UWO involving J.R. Bolton, A.C. Weedon and M.J. Stillman. Bolton and co-workers are examining the photophysics of a range of coupled PQ complexes which have different linkages between the porphyrin and quinone. These molecules are prepared by Weedon's group. The authors contribution has been to develop models of the PQ complex using isolated porphyrins and phthalocyanines, which in the presence of different electron acceptors exhibit photochemical behavior. By studying the visible-light photolysis of porphyrins (P) and phthalocyanines (Pc) in appropriate liquid and frozen solutions, the authors have been able to demonstrate the occurrence of single and, in many instances, consecutive, one-electron photooxidations for a wide range of metalloporphyrins and metallophthalocyanines. The products of these photooxidation reactions, which have been characterized by optical absorption, magnetic circular dichroism (MCD) and electron paramagnetic resonance (EPR) spectroscopies, are compared with analogous data obtained from the products of controlled-potential electrolysis experiments.

5589 (SERI/CP—233-2959, pp 20-24) **Distance dependence of intramolecular electron transfer through rigid hydrocarbon spacers.** Miller, J.R.; Penfield, K.W.; Green, N.J.; Closs, G.L. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The effects of energy, distance and molecular structure on rates of electron transfer between molecules are the subjects of continuing investigations in the authors laboratory. The use of rigid molecular spacers between electron donor and acceptor groups facilitates study of the above questions, and is a promising method to obtain energy storage with directed charge separation. Here they present recent results focusing principally on the effects of distance through rigid hydrocarbon spacers. Through-bond interaction is the dominant source of the electronic coupling which enables electron transfer to occur in a series of molecules of the type D-S-A. Pulse radiolysis measurements used molecules D (donor) = biphenyl and A (acceptor) = naphthalene attached to a series of spacer molecules, S, having 3,4,6,7 or 10 saturated hydrocarbon bonds between the D and A groups. The spacer groups were 1,3-cyclohexane (three bonds), 1,4-cyclohexane (four bonds), 2,7-decalin (six bonds), 2,6-decalin (seven bonds) and 3,16-androstance (ten bonds). They attached electrons to these molecules using Argonne's picosecond Linac and measured electron transfer rates (ET) from $3.5 \times 10^9 s^{-1}$ across three bonds to $1.5 \times 10^6 s^{-1}$ across ten bonds. The clearest understanding of the rates is obtained by comparing the electronic-coupling interactions. The electronic interactions decrease regularly with increasing number of bonds, but do not correlate very well with either edge-to-edge or center-to-center distance.

5590 (SERI/CP—233-2959, pp 27-30) **Photodissociation of organic charge-transfer complexes.** Jones, G. II. (Boston Univ., MA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The behavior of organic electron donor-acceptor (charge-transfer, CT) complexes on photolysis in polar media will be discussed. Radical or radical-ion pairs generated directly on photoexcitation are known to undergo release from solvent cages with an efficiency which depends on the wavelength of photoexcitation.

This response to the deposition of excess vibrational energy for an excited ion or radical pair is shown to be quite general. The wavelength dependence of net electron transfer for complexes has not been demonstrated for a series of small ring compounds which perform ring opening reactions via radical-cations after photoexcitation, and for complexes or ion-pairs of methyl viologen. In the latter case, combination of the viologen acceptor with electron donors with diverse electron donor agents such as aniline or naphthalene derivatives, EDTA or triethanolamine, 1,5-dithiacyclooctane, and polycarboxylates leads to complexes exhibiting broad CT transitions. Irradiation within these bands (YAG laser at 355 and 532 nm) or steady photolysis leads to radical intermediates with yields which vary in a systematic way with excitation energy.

5591 (SERI/CP—233-2959, pp 31-40) **Ion separation and bond cleavage in sensitized photoreactions.** Das, P.K. (Univ. of Notre Dame, IN). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Principally based on nanosecond laser flash photolysis and pulse radiolysis, time-resolved mechanistic studies are carried out to elucidate the roles of various photointermediates in organic photoreactions in solution. The transients of interest include singlet, triplet and doublet excites states, exciplexes and ion-pairs, carbenes and ylides, radicals and biradicals. In particular, a substantial portion of the authors efforts is directed toward primary aspects of intra- and intermolecular hydrogen-atom and electron transfer in organic systems. Besides kinetics, they determine the efficiencies of charge separation, bond homolysis, intra-ion-pair proton transfer (as applicable) and electron transfer mediated intersystem crossing. The quantitative information on the primary processes are relevant to photochemical energy conversion, dissipation and storage, as well as to mechanisms to sensitized photoreactions leading to oxidation, oxygenation, isomerization and small-molecule extrusion.

5592 (SERI/CP—233-2959, pp 43-48) **Photochemical energy storage: studies of inorganic photoassistance agents.** Wrighton, M.S. (Massachusetts Institute of Technology, Cambridge). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

This research program involves several themes: (1) specific interactions of chemical reagents with semiconductor photoelectrode surfaces, (2) photoelectrode-confined polymer/catalyst assemblies, (3) investigation of new surface-confined redox mediators for biological redox reagents, and (4) synthesis and characterization of large, multi-component redox molecules that may be useful in light absorption and charge separation when oriented on electrode surfaces. Examples of research accomplishments can be found in the publications from the past two years. The most significant development in the past nine months concerns the synthesis and characterization of a multi-component redox reagent that exhibits a kind of rectification. This subject is emphasized in the presentation of the activities during the past year. The details of the molecular rectification are developed.

5593 (SERI/CP—233-2959, pp 53-55) **Surface-modified semiconductor electrodes.** Frank, A.J.; Pern, F.J. 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Recent work in the authors laboratory has been concerned with understanding the energetics and dynamics of charge transport in electronically conductive poly(3-methylthiophene) films on platinum electrodes and the characterization of highly active molecular oxygen-evolution catalyst derived from ruthenium tris (2,2'-bipyridyl-5,5'-dicarboxylic acid). Some highlights of these studies are given.

5594 (SERI/CP—233-2959, pp 56-59) **Fundamental electron transfer processes at the single crystal semiconductor/liquid interface.** Lewis, N.S. (Stanford Univ., CA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The authors studies have focused on elucidation of the fundamental steps which control the light-induced charge separation at semiconductor/liquid interfaces. Particular attention has been paid to trends in the open circuit photovoltage, short circuit photocurrent, and fill factor of the III-V alloy series, GaAs/sub 1-x/P/sub x/ and Ga/sub 1-x/Al/sub x/As ($0<x<1.0$). They have discovered that these materials, when used as photoanodes in aqueous and nonaqueous solvents, provide extremely efficient optical-to-electrical energy conversion interfaces, and that such materials can exhibit internal quantum yields of unity over a wide range of the visible region. Additionally, the excellent charge collection properties and large open circuit photovoltages make these devices amongst the most efficient known semiconductor/liquid junctions for conversion of solar irradiation into stored electrical power.

5595 (SERI/CP—233-2959, pp 60-63) **Chemical probes of charge transfer at semiconductor/liquid junctions.** Koval, C.; Austermann, R.; Gustafson, R.; Olson, J.; Segar, P. (Univ. of Colorado, Boulder). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Semiconductor/liquid junction solar cells, which are also called photoelectrochemical cells (PEC), represent a versatile way to utilize solar energy. Photon energy can be used to make electricity and chemical fuels or as an alternative to thermal activation in photocatalytic cells. In addition, the field of electrochemistry in general has been stimulated by the recent interest in photoelectrochemistry. To a first approximation all metal electrodes behave similarly and ideas about electron transfer between molecules in solution and metal electrodes are relatively mature. On the other hand, semiconductor electrodes have properties that vary widely depending upon composition and structure, doping level, surface preparation and other factors. While models of charge transfer across the semiconductor/solution interface, particularly those developed by Gerischer, provide a widely accepted description of many photoelectrochemical processes, these models have not received the same level of experimental scrutiny as have their counterparts in metal/solution electrochemistry. In an attempt to remedy this situation, the authors are engaged in a detailed study of electron transfer kinetics across InP/CH_3CN and WSe_2/CH_3CN interfaces. They are also investigating the use of chemically irreversible redox couples for measuring the energies of photogenerated carriers as they cross the semiconductor/solution interface.

5596 (SERI/CP—233-2959, pp 64-69) **Solar photochemistry mediated by semiconductor particulate materials.** Serpone, N. (Concordia Univ., Montreal, Quebec). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The authors research follows two principle themes. The first deals with fundamental studies of the excited states of metal complexes and of semiconductors (colloids) employing the techniques of transient absorption and luminescence psec laser spectroscopy. The second focuses on applied studies in photocatalysis with semiconductor based photocatalysts. In the first, the authors question how excited states communicate with each other by probing the photophysical and photochemical primary events in transition metal complexes with a particular emphasis on the chromium(III) polypyridyl species. The work on the semiconductor colloids (TiO_2 and CdS) intends to probe the primary events upon bandgap light excitation in an effort to understand the kinetics of electron/hole recombination, the lifetimes of the charge carriers, the photosensitized electron injection into the conduction band and thus electron transfer across the semiconductor/solution interface involving various substrates. The significance of this should have an impact on

how light-driven processes occur on semiconductors. In this presentation, they shall emphasize their recent work in applied photocatalysis.

5597 (SERI/CP—233-2959, pp 73-76) **Sputtered semiconductor films for solar energy conversion.** Schumacher, L.C.; Mamiche-Afara, S.; Dignam, M.J. (Univ. of Toronto, Ontario). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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This research project is aimed at assessing the prospects of developing thin film elements for efficient photoelectrolysis of water using atomic sputtering as the principle fabrication technique. Initially the authors examined the properties of a number of reactively sputtered metal oxides as potential oxygen photoanodes and the effect of sputtering conditions etc. on these properties. This work was accompanied by extensive efficiency analysis based on a variety of configurations. As a result of this work they are now able to produce oxide films of uniform thickness that match the performance of the best polycrystalline materials. Further, they have concluded that for efficient photoelectrolysis of water via an unbiased photoelectrochemical cell (PEC) the best prospect appears to be a two photon tandem PEC consisting of e.g. a wide bandgap (~ 2.0 eV) n-type semiconductor with properties suitable for performing as an oxygen photoanode, deposited on top of a photovoltaic element of bandgap ~ 1.4 eV (e.g., p-n amorphous H-Si). An overall efficiency (total solar radiant energy to chemical free energy as H_2 in bias free operation) of 16 to 18% appears to be a practical goal for such a configuration. As Fe_2O_3 is stable under photoanodic conditions in alkaline solution and has close to the optimum flatband potential and bandgap for such a device, they have devoted the last two years largely to the study of this oxide and for purposes of comparison another, In_2O_3, having a similar crystal structure. The results of these studies are presented here.

5598 (SERI/CP—233-2959, pp 77-79) **Photocatalyzed production of hydrogen and ammonia from H_2O and N_2 over iron oxide.** Somorjai, G.A.; Hendewerk, M.; Vurens, G.; Khader, M.; Leygraf, C.; Turner, J.; Salmeron, M. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The main strength of the authors research efforts is the combination of surface science studies of photochemically active materials on the atomic scale combined with catalytic reaction rate studies. This way, the reaction rates and product distributions along with other kinetic parameters are correlated with the surface composition and surface structure. They are also synthesize new materials in single crystal or polycrystalline forms and characterize the bulk structure and composition with suitable experiments ranging from x-ray diffraction to Moessbauer spectroscopy. This approach has been utilized to investigate the photocatalyzed production of hydrogen and ammonia from water and nitrogen gas over iron oxide.

5599 (SERI/CP—233-2959, pp 80-82) **Electrochemical and optical studies of model photosynthetic systems.** Cotton, T.M.; Uphaus, R.A.; Feng, Q.; Heald, R. (Univ. of Nebraska, Lincoln). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Surface Enhanced Raman Spectroscopy (SERR) was used to monitor electron transfer between redox active molecules in separate monolayers. Adsorption of solution species on semiconductor surfaces was monitored during photoelectrochemical experiments. In addition the role of structure in the electrochemical properties of adsorbed porphyrins has been studied. Recent work has shown that bacteriochlorophyll a has an electron transfer constant, k/sub s/, that is strongly dependent on the solvent.

5600 (SERI/CP—233-2959, pp 83-86) **Manganese III porphyrins as potential oxidation catalysts in an artificial photosynthesis assembly.** Spreer, L.O.; Maliyackel, A.C.; Otvos, J.W.; Calvin, M. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The development of stable and efficient oxidation catalysts is essential to the production of an artificial photosynthesis assembly capable of converting solar energy to storable high energy chemical compounds. A useful oxidation catalyst in an assembly designed to split water would mediate the four-electron conversion of water to oxygen. An alternate goal would be to produce other, useful intermediate oxidants. In connection with their interest in artificial photosynthesis they have examined manganese porphyrin compounds as potential catalysts of this type. Their interest in manganese porphyrin compounds is long standing and originated in the knowledge that some type of manganese complex is involved in the oxidation cycle of natural chloroplasts. The porphyrin ligands are resistant to irreversible oxidation or reduction reactions, and this is a very desirable property since it increases the possibility for the central metal ion to participate in redox reactions. A primary requisite for a multiple electron redox catalyst is the accessibility of a variety of oxidation states, and manganese porphyrin species have been characterized with manganese in the +2, +3 and +4 levels and species have been proposed for the +5 state. In addition, there have been recent reports of the use of manganese porphyrins as oxidation catalysts for a variety of organic substrates. A major goal of their work is directed at characterizing various highly oxidized manganese porphyrin species and studying their chemistry with the view of judging their potential usefulness in the oxidation cycle of an artificial photosynthesis assembly.

5601 (SERI/CP—233-2959, pp 87-90) **ESR and ENDOR Study of porphyrins.** van Willigen, H. (Univ. of Massachusetts, Boston). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Chlorophyll dimers are involved in the primary events taking place in reaction centers of photosynthetic bacteria and green plants. Spectroscopic studies of reaction center (in vivo) chlorophyll and monomer (in vitro) chlorophyll reveal profound differences in characteristics of the in vivo and in vitro systems. Studies of model dimer molecules and their monomer precursors can establish to what extent the photophysics and chemistry of reaction center chlorophyll is determined by dimer geometry. Research reported on here is concerned with two areas of interest: (a) the effect of dimerization on the characteristics of the photoexcited triplet state of a series of porphyrins and metalloporphyrins, and (b) photooxidation of porphyrin monomers and dimers.

5602 (SERI/CP—233-2959, pp 93-99) **Magnetic resonance of ultrafast photochemistry.** Norris, J.R.; Tang, J.; Tiede, D.M.; Smith, U.H.; Budil, D.E.; Lin, C.P.; Bowman, M.K. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The initial photochemistry of bacterial photosynthesis is known to occur in a few picoseconds within a protein reaction center containing four bacterial chlorophylls, two bacteriopheophytins, and two quinones. Two of the four bacteriochlorophylls, $BChl_s$, form the primary donor special pair and one of two bacteriopheophytins serves as the primary acceptor. One of the extra bacteriochlorophyll molecules, BChl/sub B/, bridges the special pair donor cation and the primary acceptor bacteriopheophytin anion. The authors have investigated the cation, the triplet, and the initial radical pair associated with the process of photoinduced charge separation in photosynthesis using fourier transform electron paramagnetic resonance (FT-EPR), electron spin echo (ESE), reaction yield detected magnetic resonance (RYDMR), and electron para-

magnetic resonance (EPR) in protein single crystals and model compounds.

5603 (SERI/CP—233-2959, pp 100-104) **Solvent effects in photosynthesis: role of the protein.** Tiede, D.M.; Norris, J.R.; Wasielewski, M.; Breton, J. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Reaction specificity is a key feature of biological photosynthesis. This specificity is even seen in the earliest photochemistry. The x-ray structure of R. viridis has shown that tow pairs of bacteriochlorophyll and pheophytin are arranged at precisely equivalent positions about the c2 symmetry axis of the bacteriochlorophyll special pair, B_3. However, spectroscopic evidence has shown that only one pair functions as an electron acceptor. This absence of two reaction pathways in spite of the structural equivalence shows that the differences in reactivity are likely to be due to differences in the protein solvent around the bacteriochlorophyll and pheophytin molecules. Protein determined reaction specificity is also seen at the level of interprotein electron transfers. For example the rates of electron transfer between the c-cytochromes and the oxidized B_3 in the reaction center depend upon the amino acid sequence of the cytochrome. In this case, orientation of the cytochrome when bound to the reaction center is presumed to be in part responsible for the variation in reaction rate. However, the molecular orientations required for electron transfer are not known. In this program they are investigating the mechanisms which regulate porphyrin reactivity in protein environments.

5604 (SERI/CP—233-2959, pp 105-109) **High resolution laser spectroscopies as applied to photosynthetic pigments and aggregates.** Carter, T.P.; Jankowiak, R.; Gillie, K.; Small, G.J. (Ames Lab., IA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Knowledge of the structure of reaction centers is required to explain the electronic energy and electron transfer encountered in photosynthesis. High resolution spectroscopies, including fluorescence line narrowing, line narrowed fluorescence excitation, hole burning, and 4-wave mixing, are being applied to the study of isolated and in vivo reaction centers and artificial aggregates.

5605 (SERI/CP—233-2959, pp 110-114) **Photophysical properties of pure and mixed mono- and multilayer arrays of chlorophyll a.** Leblanc, R.M. (Universite du Quebec a Trois-Rivieres). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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In the inner membrane of the chloroplast, there is a particular state of chlorophyll a (chl a) which is responsible for the high efficiency of the charge separation. The interpretation of the spectra of in vitro chl a systems may help the authors better understand the state of chlorophyll in plants. The spectroscopic study of chl a in mono- and multilayers is particularly important because this system simulates the orientation of membrane systems. They have, therefore, employed electronic, emission, fluorescence lifetime, photoacoustic and photovoltaic measurements to examine the properties of the pigment in pure and mixed mono- and multilayer arrays.

5606 (SERI/CP—233-2959, pp 115-119) **Photoinduced electron transfer reactions sensitized by chlorophyll in lipid bilayer vesicles.** Tollin, G.; Ford, W.E.; Senthilathipan, V.; Rong, S. (Univ. of Arizona, Tucson). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The goals of this research program have been to elucidate the detailed mechanisms of light-induced one-electron transfer reactions involving chlorophyll and electron donors and acceptors in lipid bilayer vesicles, and to determine the interactions between the elementary steps in these processes and parameters such as bilayer viscosity, surface electrical charge, and donor and acceptor structure. The authors wish to develop a body of fundamental information which can be used to devise strategies for increasing the yields of the high energy products of such reactions, to physically separate these products so as to decrease the probability of reverse electron transfer (i.e. back reactions), and to facilitate secondary electron transfer to external donors and acceptors. Such information should prove useful in the development of biomimetic systems for practical solar energy conversion based on green plant photosynthesis.

5607 (SERI/CP—233-2959, pp 120-125) **Structural aspects of photoinduced charge separation in micellar and vesicular media.** Kevan, L. (Univ. of Houston, TX). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Photoionization can store light energy if net charge separation is achieved. Rapid ion recombination back reactions can be significantly slowed by the utilization of organized molecular assemblies such as micelles and vesicles. The authors approach focuses on the structural aspects controlling charge separation. The experimental thrust utilizes electron spin resonance (ESR) to detect the paramagnetic photoproduced cations and to probe their interactions with their surroundings. Net charge separation can be detected by ESR in frozen solutions where the back reactions are inhibited. Photoproduced cation-water interactions and other structural information with regard to the surfactant molecules can be studied by electron spin echo modulation (ESEM) which enables the determination of weaker electron-nuclear hyperfine interactions than one can normally detect by ESR. The ESEM technique is particularly well adapted to the study of disordered systems like micelles and vesicles. The modification of micellar surfaces is being studied to optimize the photoionization efficiency of micellized solutes. One approach is to use slightly water soluble alcohols. The ESEM and ESR spectra of the photogenerated, N,N,N',N'-tetramethylbenzidine cation radical (TMB^+) in frozen micellar solutions of sodium- and tetramethylammonium dodecylsulfate (SDS and TMADS respectively) as well as dodecyltrimethylammonium chloride (DTAC) have been studied as a function of 1-butanol (1-BuOH) concentration. The efficiency of TMB photoionization is determined from ESR data, while ESEM analysis gives information about micelle hydration and aqueous interactions of TMB^+.

5608 (SERI/CP—233-2959, pp 161-170) **Photochemical energy conversion and solution kinetics.** Creutz, C.; Sutin, N.; Brunschwig, B.S.; Winkler, J.R.; Netzel, T.L. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Because they strongly absorb visible light and readily undergo electron-transfer reactions, transition-metal complexes are excellent mediators of outer-sphere light-induced redox reactions, many of which effect net storage of the light energy. In addition, because of their ability to promote the formation or activation of small molecules, transition-metal complexes can provide homogeneous catalytic routes for the thermal and photochemical formation of H_2 or activation of CO_2. A major objective of this program is the quantitative study of excited-state physical and chemical deactivation processes; the lifetimes of excited states and the rates of electron-transfer reactions of excited-state and ground-state complexes are being determined and modeled, and mechanistic studies of the reactions of transition-metal ions in high and low oxidation states are being conducted.

5609 (SERI/CP—233-2959, pp 171-173) **Oligomer and mixed-metal compounds: potential multielectron transfer agents.** Rillema, D.P.; Sahai, R.; Ross, H.; Whitmoyer, D.E. (Univ. of North Carolina, Charlotte). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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A continuing theme in photochemistry is the use of metal-to-ligand charge transfer excited states in a variety of photochemical applications. Consequently, considerable effort has been expended to understand the nature of this state. Nonradiative decay from this state has been shown to follow the energy gap law. One complication in ruthenium(II) complexes is the existence of relatively low lying d-d states which, when thermally populated, provide an additional decay pathway. In addition, there is evidence for another decay channel via a fourth CT state, one with more singlet character, that can also be thermally populated. In the authors work, they seek to control the natural of the excited state by synthetically varying the lumophoric and nonlumophoric ligands coordinated to ruthenium(II). These variations not only allow control of the position of the d-d state but also provide a family of excited state redox potential for various applications. In addition, they seek to synthesize compounds that contain a light absorbing center and a reactivity center in one molecule. This would eliminate the need of a donor-acceptor pair combination in order for energy or an electron to transfer from the photoactive center to the reactivity site. They also seek to design catalysts capable of multielectron transfer which would be mechanistically capable of reducing or oxidizing substrates in two electron steps.

5610 (SERI/CP—233-2959, pp 174-177) **Energy transformations in organometallic complexes.** Watts, R.J.; King, K.; Garces, F.; Spellane, P.; Craig, C. (Univ. of California, Santa Barbara). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Energy transformations are being studied in organometallic complexes of iridium and ruthenium. Early work was concerned with dichloro-bridged dimers with 2-phenylpyridine or benzo[h]quinoline ligands. The present work is investigating the emission spectra of [Ir(ppy)/sub n/(bpy)/sub 3-n/]/sup (3-n)+/ where ppy is 2-phenylpyridine and bpy is bipyridine.

5611 (SERI/CP—233-2959, pp 178-181) **Photochemistry and photophysics of polymetallic complexes.** Petersen, J.D. (Clemson Univ., SC). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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This research concentrates on the preparation, characterization, and photochemistry of polymetallic complexes each containing three integral parts: a highly absorbing, photochemically nonreactive metal center (antenna fragment); a metal enter capable of a useful photochemical reaction (reactive fragment); and a highly-communicative bridging ligand coupling the two metal centers. In the authors development of a single molecular system for photoproduction of hydrogen using visible light and this three-part approach, they have prepared polymetallic complexes with a variety of metal centers, bridging ligands, and terminal ligands. The various perturbations that can be made on the extent of metal/metal interaction and ground and excited state redox potentials by varying these three components give a great deal of flexibility to the design of useful molecular systems for excited-state, energy- or electron-transfer reactions.

5612 (SERI/CP—233-2959, pp 182-185) **Electronic structure studies of molecular clusters and related electron transfer properties.** Newton, M.D. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The goal of this program is to elucidate the energetics and kinetic properties of molecular clusters and complexes by exploiting the techniques of ab initio electronic structure theory. Primary emphasis is placed on fundamental aspects of metal-ion complexes in aqueous solution, including the dependence of their properties on ion-charge, and the mechanisms of their charge transfer reactions. Ab initio electronic structure calculations have been carried out for various aquo and ammine complexes of Fe, Co, and Ru in their 2+ and 3+ oxidation states, and also the closed-shell ions Na^+, Mg^{2+}, and Al^{3+}. The results of these calculations have been tested against available thermodynamic as well as molecular and electronic structural data from experiment, and have also been employed in assessing a variety of factors controlling electron transfer kinetics. These include the charge-state dependence of various inner shell geometrical parameters and associated vibrational frequencies (metal-ligand and intra-ligand stretching modes, and librational modes), and the dependence of electron transfer matrix elements on the nature of the ligand (H_2O vs. NH_3) and the metal orbital type.

5613 (SERI/CP—233-2959, pp 189) **Structure and redox chemistry of oxoporphyrins.** Barkigia, K.M.; Chang, C.K.; Fujita, E.; Stolzenberg, A.M.; Fajer, J. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Oxoporphyrins form a family of porphyrin derivatives substituted with keto functions at the peripheral β positions. The recent proposal by Chang that a dioxoisobacteriochlorin comprises the green prosthetic group of dissimilatory nitrite reductases has prompted an investigation of this hitherto poorly characterized class of compounds. Single crystal structural determinations of free base and Cu(II) dioxoisobacteriochlorins, and of a free base dioxobacteriochlorin offer the first structural parameters for dioxoporphyrins. Bond distances parallel those found in other hydroporphyrins. The redox chemistry of the oxoporphyrins is noteworthy. The oxocompounds exhibit ring oxidation potentials very similar to those of the parent porphyrin, in sharp contrast to those of chlorins, isobacteriochlorins and bacteriochlorins which are significantly easier to oxidize than the porphyrin (by as much as 0.6V). Again, in contrast to the behavior of isobacteriochlorin derivatives which are harder to reduce than porphyrins by ~0.3V, the dioxoisobacteriochlorins are easier to reduce by ~0.2V for a net change of ~0.5V in potential upon introduction of the dioxo functions onto the isobacteriochlorin skeleton. The Fe(II)-Fe(III) couples also shift so that metal centered reductions become easier.

5614 (SERI/CP—233-2959, pp 190) **Enhanced stability and efficiency via overlayer formation in the cadmium chalconide/Fe(CN)$_6$/sup 4-/3-/ photoelectrochemical cell.** Bocarsly, A.B.; Arent, D.J.; Rubin, H.D. (Princeton Univ., NJ). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Irradiation of n-CdX (X=S,Se,Te) photoelectrodes in an electrolyte containing Fe(CN)$_6$/sup 4-/3-/ causes formation of a [Cd/sup II/Fe/sup II/III/(CN)$_6$]/sup 4-/3-/ surface layer on the electrode which is detectable by diffuse reflectance FTIR analysis. This layer is shown to play an integral role in the interfacial charge transfer process, and is responsible for Gerischer's previous report of partial stabilization of n-CdS by a ferrocyanide electrolyte. It is demonstrated that the heterogeneous interfacial charge transfer rate along with the ability of the surface layer to interact with photogenerated valence band holes and reduced solution species is a strong function of the alkali cations present in the zeolitic surface layer sites. Appropriate choice of cations has allowed the development of an n-CdS/Fe(CN)$_6$/sup 4-/3-/ photoelectrochemical cell which is dramatically stabilized when compared to the original literature reports. It is further found that ability to control surface processes leads to monochromatic efficiencies (488 nm) in excess of 20% and fill factors of ~65%. This is to be compared with an efficiency of ~8% (at 488 nm) for the original Fe(CN)$_6$/sup 4-/3-/ cell and only ~5% for the well investigated n-CdS/polysulfide photoelectrochemical cell. Likewise, the fill factor, a measure of the interfacial charge transfer kinetics, yields a threefold improvement in comparison to previously reported systems.

5615 (SERI/CP—233-2959, pp 191) **Mechanism of the photochemistry of p-benzoquinone in aqueous solutions.** Ononye, A.I.; McIntosh, A.R.; Bolton, J.R. (Univ. of Western Ontario, London). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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p-Benzoquinone (BQ) in aqueous solution at pH ~7 undergoes a fairly clean photochemical reaction with the stoichiometry 2BQ hnu/→ BQH_2 + HO-BQ where BQH_2 is hydroquinone and HO-BQ is 2-hydroxy-p-benzoquinone. Bridge and Porter first suggested that the primary step involves hydrogen abstraction from H_2O by the triplet excited state of BQ. However, an alternative mechanism has been proposed, namely a photosolvation of ^3BQ to form a hydrated intermediate which then reacts with BQ in secondary reactions. The main problem in the previous studies has been the lack of convincing evidence to prove or disprove the presence of free -OH in this system. The authors approach to the study of the mechanism of the BQ photochemistry has been to utilize the technique of spin trapping, first on a system known to yield free -OH radicals [the photolysis of H_2O_2] and then on the BQ system. The spin trap used was 5,5'-dimethyl-1-pyrroline-1-oxide (DMPO). Their results point clearly to the presence of free -OH as a primary photoproduct.

5616 (SERI/CP—233-2959, pp 192) **Photophysics of the intramolecular photochemical electron transfer in a porphyrin-amide-quinone molecule.** Bolton, J.R.; Schmidt, J.A.; McIntosh, A.R.; Siemiarczuk, A.; Weedon, A.C.; Connolly, J.S.; Hurley, J.K.; Wasielewski, M.R. (Univ. of Western Ontario, London). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The authors have carried out a thorough study of the photophysics of a porphyrin-amide-quinone (PAQ) molecule as well as the corresponding hydroquinone ($PAQH_2$). They find that PAQ is photochemically active via photochemical electron transfer in both the excited single (S_1) and triplet (T_1) states, whereas $PAQH_2$ is photochemically inactive. They have measured the fluorescence lifetimes for PAQ and $PAQH_2$ in many solvents, and these measurements provide estimates for the forward electron transfer rates from the S_1 state of porphyrin to the quinone in PAQ. They then chose several solvents, such as 1-butanol and benzonitrile, where electron transfer rate constants are favorable, and performed laser flash-photolysis measurements with optical detection in an attempt to detect the p^+. - Q^-. state at room temperature.

5617 (SERI/CP—233-2959, pp 193) **Electron transfer in chlorophyll micelles.** Bowman, M.K.; Michalski, T.J.; Norris, J.R.; Katz, J.J. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Micelles of hydrated chlorophylls and bacteriochlorophylls form in hydrocarbon solutions. The addition of small amounts of electron acceptors oxidizes a small fraction of the chlorophyll or bacteriochlorophyll in these micelles to produce radical cations. The addition of 1 to 100 milli-equivalents of iodine produces a large number of radical cations without the formation of detectable, irreversible degradation products. At room temperature, these radical cations are mobile, paramagnetic species with magnetic resonance spectra which are strongly reminiscent of organic electrical conductors. The transfer of electrons (holes) between neutral molecules and radical cations depends strongly on the particular pigment which composes the micelles. The authors have measured the electron transfer times for a number of pigment micelles at room temperature and find a large variation: .93ns for chlorophyll a, 3.6ns for bacteriochlorophyll a and >1.0 microsecond for pyrochlorphyll a. This variation with pigment represents both changes in the intermolecular interactions due to differences in molecular structures as well as changes in intermolecular overlap due to differences in the micelle structure. Electron transfer times have a weak temperature dependence, varying smoothly by about a factor of 10 between 77K and 300K. The electron spin resonance (ESR) lineshape as measured by conventional as well as Fourier Transform ESR show subtle deviations from a lorentzian lineshape.

5618 (SERI/CP—233-2959, pp 194) **Electron transfer in covalently linked porphyrin-quinone molecules.** Connolly, J.S.; Marsh, K.L.; Bell, W.L.; Hurley, J.K. 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

As part of an on-going study of light induced electron transfer in flexibly linked donor-acceptor systems, the authors have synthesized some ester-linked porphyrin-antraquinones abbreviated PE(AQ). They denote the porphyrin itself as MTTP and the quinone as AQ, where M = H_2 or Zn. They have measured the fluorescence lifetimes and triplet-state decay kinetics of the porphyrin moieties in these linked systems and have compared the results with bimolecular quenching constants in solutions of the non-linked molecules in several solvents of varying dielectric constant.

5619 (SERI/CP—233-2959, pp 196) **Electron transfer reactions on small CdSe colloids.** Dimitrijevic, N.M.; Kamat, P.V. (Univ. of Notre Dame, IN). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Colloidal CdSe particles were investigated by both laser flash photolysis and pulse radiolysis. Electron transfer reactions were observed from each technique. Transient absorption attributed to trapped excess charge and formation of Cd^+ and Se^- sites was detected during the laser photolysis. Transient absorption was again detected during pulse radiolysis of the aqueous solution. In the latter case the trapped excess charge is reduced to Cd^0 in short order.

5620 (SERI/CP—233-2959, pp 197) **Quantitative estimation of solvent reorganization energies for electron transfer processes.** Brunschwig, B.S.; Ehrenson, S.; Sutin, N. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Approximation techniques are presented for the calculation of solvent reorganization energies in electron transfer processes. The approximations take advantage of the small errors introduced by neglecting energy dependence for the cavity dielectric for charge-transfer sites within prolate ellipsoidal and spherical cavities. An analytic approximation is presented for the spherical cavity and a Taylor series approximation is presented for the ellipsoidal cavity.

5621 (SERI/CP—233-2959, pp 199) **Chlorinated chlorophylls: components of green plant reaction centers?.** Fujita, E.; Chadwick, B.; Frank, H.; Simpson, D.; Smith, K.M.; Fajer, J. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Chlorinated chlorophyll (Chl) derivatives, extracted from photosystem I preparations of spinach, cyanobacteria and green algae, have been proposed by Dornemann and Senger to be integral parts of PS I reaction centers. This novel proposal is tempered, however, by the fact that δ-chloro Chl and 10-hydroxy, δ-chloro Chl, possible candidates for these chromophores, are readily synthesized by reaction of Chl a derivatives with mild oxidizing agents and chloride, so that the chlorinated Chl identified by Dornemann and Senger may result from reactions that occur before or during the isolation procedure. The possibility that these compounds function as primary donors (P700) or acceptors (A_0 or A_1) is considered by comparing their properties with those of Chl a in vitro and those of P700, $P700^+$, A_0^- and A_1^- in vivo. The triplet zero field splittings of the chlorinated compounds, and the redox, optical and ESR characteristics of their anions and cations do not differ widely from those of Chl a. These results do not offer, therefore, clear diagnostic signatures that would unambiguously identify the putative chlorinated species in vivo, not do they provide obvious advantages

(or disadvantages) for a biological role for chlorinated chromophores.

5622 (SERI/CP—233-2959, pp 200) **Excitation transport and electron transfer in disordered systems: theory and experiment.** Fayer, M.D. (Stanford Univ., CA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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A general theoretical approach for the description of electronic excitation transport in disordered systems having any structural geometry has been developed. The method involves a truncated cumulant expansion. Previous theories have involved highly accurate infinite order density expansions. However, the density expansion methods, which have been extremely successful in isotropic three-dimensional systems become mathematically intractable when applied to more complex structures. The two particle cumulant expansion permits complex structures to be handled. The authors have applied the new method to a two-dimensional system of chromophores and have properly included the various types of dipole-dipole angle averages. They next treated a bilayer, i.e., a pair of planes with various separations. They have also solved the problem of a finite or infinite stack of planes with uniform or nonuniform spacings. The stacked systems exhibit fractal-like behavior under certain circumstances. Finally, they applied the theory to chromophores randomly attached to isolated polymer coils. The now have a quantitative theory for excitation transport in a certain class of polymer systems. Experimentally, they are using fast time resolved fluorescence depolarization and picosecond transient polarization gratings to directly examine excitation transfer among chromophores in polymer systems and multibilayers (a system of stacked planes).

5623 (SERI/CP—233-2959, pp 202) **Photochemical solar energy conversion utilizing semiconductors localized in membrane mimetic systems.** Fendler, J.H. (Syracuse Univ., NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Surfactant vesicles continue to be utilized as hosts for colloidal semiconductors. Quantum size effects of in situ generated colloidal CdS, ZnS semiconductors and their mixtures have been investigated in positively charged dioctadecyldimethylammonium chloride (DODAC) surfactant vesicles. These semiconductors have been localized at the exterior, at the interior or at both of these sites of the vesicles. Sizes of vesicle stabilized colloidal semiconductors could be varied from 20 A to 200 A in diameter. The photochemical behavior of the ultrasmall colloidal semiconductors has been found to be governed by the nature of the surface states, rather than by the band model predictions. Doping of vesicle entrapped CdS by Zn^{2+} moved the surface states to higher energy and rendered this semiconductor to be more photoactive than pure CdS. Absorption and emission spectroscopy have been utilized for the characterization of these microheterogeneous systems. Laser flash photolysis initiated transient absorption spectroscopy in the pressure of adsorbed electron donors and acceptors have provided information on charge transfer efficiencies.

5624 (SERI/CP—233-2959, pp 203) **Magnetic field effects on the photochemistry of coordination complexes.** Ferraudi, G.J. (Univ. of Notre Dame, IN). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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In connection with the authors studies about the mechanism of interaction of intense magnetic fields with excited states of coordination complexes, the authors have examined the behavior of excited Cr(III) and Co(III) complexes. For $CrLL_6^{3+}$ (LL = bipyridine, 1,10-phenanthroline, 4,7-diphenyl-1,10-phenanthroline), flash photolysis shows that the presence of the magnetic field induces larger transient changes of the optical density at those wavelengths corresponding to the spectrum of the lowest lying doublets. The observation of a Zeeman effect on the emission of these complexes is in agreement with a magnetic field-induced splitting of an orbitally degenerated, e.g. ^2T, excited state and suggests that (in a LF-model) the magnetic field perturbation has taken precedence over D/sub 3d/-distortions from O/sub h/ symmetry. In $Co(CN)_6^{3-}$ the large width of the emission spectrum impeded the observation of similar Zeeman splittings and the lifetime of the excited state changes by less than a 3% under conditions (crystalline samples) where the compound exhibits no photoreactivity. The magnetic field has, however, a pronounced effect on the photosubstitution reaction of the complex in fluid solutions, namely increasing the photosubstitution yield by 100% at 70 KGauss. It is possible to correlate such an increase in the photoreactivity with a larger rate of reaction from the Jahn-Teller distorted excited state.

5625 (SERI/CP—233-2959, pp 204) **Photon energy through singlet oxygen chemistry.** Chou, P.T.; Frei, H. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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In the authors study of photon storage through chemical storage of singlet molecular oxygen, the authors have obtained first direct evidence for O_2 ($^1\Delta$/sub g/) thermally expelled from an endoperoxide, that of 1,4-dimethylnaphthalene in halocarbon solution, by observation of O_2 $^1\Delta$/sub g/ $\rightarrow$ ^{3}Sigma/sub g/$^-$ thermoluminescence at 1.3 micron. ET-IR spectroscopic study of the thermal decomposition of the endoperoxide did not reveal any other product absorptions than those attributed to 1,4-dimethyl-naphthalene, demonstrating that decomposition of the endoperoxide on the ground electronic surface regenerates the parent naphthalene and O_2 quantitatively. Similarly, $^1\Delta$/sub g/ $\rightarrow$ ^{3}Sigma/sub g/$^-$ emission has been observed upon thermal decomposition of the endoperoxide in aqueous solution. These results, and a study of the gas phase decomposition of the singlet oxygen expelling 2-methylfuran hydrotrioxide with high vibrational overtone-singlet O_2 luminescence excitation spectroscopy are presented.

5626 (SERI/CP—233-2959, pp 205) **Microcomputer-aided analysis in photochemical studies.** Browett, W.R.; Nyokong, T.; Gasyna, Z.; Stillman, M.J. (Univ. of Western Ontario, London). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The full characterization of a photochemical reaction requires analysis of both the chemistry involved, as well as the photophysical properties. In the authors studies of the photochemical oxidation of porphyrins and phthalocyanines, they have investigated the spectroscopic properties of the reaction products using optical absorption and magnetic circular dichroism (MCD) spectroscopies, and the reaction kinetics using fluorimetric techniques. A microcomputer-based package of programs has been developed using the IBM S9001 laboratory computer and the Fortran 77 compiler. This package of programs has been used extensively in both the data acquisition and data analysis aspects of their research. Absorption and MCD spectra were recorded during irradiation of both porphyrin and phthalocyanine complexes in the presence of electron acceptors in order to characterize the product of the photolysis. These data were obtained with high quality using the real-time, interactive, instrument control program CDSCAN5. The SIMPFIT program, which is based on a versatile Simplex algorithm, was used to perform deconvolution of spectral envelopes of both absorption and MCD data.

5627 (SERI/CP—233-2959, pp 206) **Photobiocatalytic water splitting: structural and kinetic studies.** Greenbaum, E.; Woodward, J.; Allison, D.P.; MacDougall, C.S.; Heller, A.; Brown, J.M.; Sheng, T.T. (Oak Ridge National Lab., TN). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Platinized chloroplasts have been prepared from colloidal platinum and photosynthetic thylakoid membranes using photochemical deposition. These chloroplasts have been studied by transmission electron microscopy (TEM). A platinum-outlined membra-

nous structure was observed. A TEM study of a liquid sample of the chloroplasts detected platinum particles. In a related study, it was determined that manganese chloride enhances photoactivity of the prepared chloroplasts.

5628 (SERI/CP—233-2959, pp 207) **Theoretical and structural studies of Mn(III) peroxo complex.** Hanson, L.K.; VanAtta, R.B.; Strouse, C.E.; Valentine, J.S. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Theoretical and structural studies were conducted on a Mn(III) peroxo complex that is a useful probe of O-Mn chemistry in photosynthesis. A K^+-cryptate salt of the complex was investigated by x-ray analysis. Spectroscopic investigations of the complex detected a single Soret band and an occupied Mn d/sub x^2-y^2/ orbital. These were not found in the x-ray analysis. Charge iterative extended Hueckel calculations succeeded in reconciling the spectroscopic and crystallographic data. Combining the calculated results with optical and ESR data, the formation of peroxo Mn(IV) was predicted.

5629 (SERI/CP—233-2959, pp 208) **Picosecond laser spectroscopy of chromium(III)-polypyridyl complexes.** Serpone, N.; Hoffman, M.Z. (Corcordia Univ., Montreal, Quebec). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

A neodymium:YAG laser was used for pulsed photolysis of aqueous solutions $Cr(NN)_3^{3+}$ (NN = 2,2'=bipyridine, 1,10-phenanthroline, and substituted analogs). The samples displayed two emission components, a fast one for $\lambda < 600$ nm and a slow one for $\lambda \sim 700$ nm. Transient absorption changes were also observed. The emission and absorption features were attributed to ligand-localized excited states.

5630 (SERI/CP—233-2959, pp 209) **Binuclear ruthenium complexes as catalysts for water oxidation.** Hurst, J.K. (Oregon Graduate Center, Beaverton). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Oxidative reactions of $Ru[5,5'\text{-}(HOOC)_2\ bpy]^{3+}$, where bpy = bipyridine, form μ-oxo dimers. The dimers have been found to exhibit superior catalytic properties for water oxidation. Optical spectra obtained from the products of the reaction of $Ru[5,5'\text{-}(HOOC)_2\ bpy]_3^{2+}$ with $S_2O_8^{2-}$ show that Ru(III, IV) and Ru(III, III) μ-oxo ions are involved in the photolysis and thermolysis products, respectively.

5631 (SERI/CP—233-2959, pp 210) **Electron transfer reactions in colloidal semiconductor systems.** Kamat, P.V. (Univ. of Notre Dame, IN). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Photocorrosion and electron transfer in suspensions of CdS particles in acetonitrile have been studied using laser pulse excitation. An emission maximum was observed in the 600-700 nm region. Dyes were used as electron scavengers and I^- and SCN^- as hole scavengers. Conduction band electrons were suggested to be responsible for bleaching recovery when they reacted with bulk and surface traps.

5632 (SERI/CP—233-2959, pp 211) **Small angle neutron scattering of chlorophyll micelles: models for bacterial antenna chlorophyll.** Worcester, D.L.; Michalski, T.J.; Bowman, M.K.; Katz, J.J. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Artificial chlorophyll systems such as the chlorophyll/water micelles were studied because their characteristics are close to those of in vivo chlorophyll. The systems of most interest are the micelles formed by hydration of chlorophyll oligomers in nonpolar organic solvents. Small angle neutron scattering was used to characterize the micelles. Each micelle was found to be a hollow cylinder with an interior cavity large enough to accommodate large peptides. Electron paramagnetic resonance was used to determine the fine structure of the macrocycle arrangements.

5633 (SERI/CP—233-2959, pp 212) **Probability of electron transfer between ferrous and ferric hexa-aquo complexes as a function of separation.** Kestner, N.R.; Magestro, P. (Louisiana State Univ., Baton Rouge). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Using a semiempirical potential for water-water interactions generated by Reimer, Watts, and Klein modified by the polarization effects due to the ions, they have evaluated the interaction between two iron hexa-aquo complexes. This potential was then used to evaluate the probability of electron transfer versus distance by including the interaction terms calculated by Newton. This differs from earlier work by the explicit inclusion of the details of the angular dependences of the interaction. This is especially important since the interaction appears to occur primarily at distances where such effects are important. The authors also will comment on the effect of ions on the basic potential using studies carried out in this laboratory by Mathers and related work by Hermansson. A novel feature of the calculations is the use of adaptive Monte Carlo techniques for the evaluation of these multidimensional integrals. Work in progress includes the effect and probability of distortion in the octahedral complexes.

5634 (SERI/CP—233-2959, pp 213) **EPR Study of carotenoid and related polyene cation radicals.** Kispert, L.D.; Joseph, J. (Univ. of Alabama, Tuscaloosa). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The β-carotene cation was observed in a solution of β-carotene in CCl_4. The solution was irradiation by a pulsed excimer laser and analyzed by electron paramagnetic resonance (EPR) methods. Attempts to detect the cation following x-ray irradiation of β-carotene in the dark failed. Related polyene cation radicals were observed by EPR methods in irradiated freon matrices. Failure to observe the β-carotene cation under the latter circumstances has not been explained.

5635 (SERI/CP—233-2959, pp 214) **Synthesis and characterization of novel systems for the study of electron transfer involving metalloproteins.** Peerey, L.M.; Ratilla, E.M.; Brothers, H.M. Jr.; Kostic, N.M. (Iowa State Univ., Ames). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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The authors are designing novel types of systems for the direct measurement of the rates of electron-transfer reactions in metalloproteins, where the intramolecular process of interest is not obscured by the formation of the precursor complex. Their systems correspond to permanent (nondissociating) precursor complexes for the intermolecular oxido-reduction between proteins and allow systematic variation of donor-acceptor distance, nature of the intervening medium, and thermodynamic driving force.

5636 (SERI/CP—233-2959, pp 216) **Synthesis of multinuclear phthalocyanines for use in photo and electrocatalysis.** Leznoff, C.C.; Marcuccio, S.M.; Lam, H.; Greenberg, S.; Lever, A.B.P. (York Univ., Toronto, Ontario). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Binuclear phthalocyanines covalently linked through the benzo groups have been prepared for the first time. The linking groups span 1, 2, 4 or 5 atoms and it was shown that coupling between the phthalocyanine groups can occur cofacially through the 4 or 5 atom linked phthalocyanine dimers or directly by conjugation through one atom oxygen linkage. A new planar binuclear phthalocyanine, sharing a common benzo group and hence capable of direct coupling of the two phthalocyanine nucleii, has now been synthesized from the bis diiminoisoindoline of 1,2,4,5-tetracyanobenzene and the diiminosoindoline of 4-neopentoxyphthalonitrile. A tetranuclear phthalocyanine, constrained to exist as two pairs of cofacial phthalocyanine nucleii has been made. The di and tetracobalt(II), derivatives of these phthalocyanines, have been prepared and fully characterized for use as photo and electrocatalysts.

5637 (SERI/CP—233-2959, pp 217) **Intramolecular CT excited states of 9-carbonyl substituted anthracenes: direct observation of C-H...O hydrogen bond in a supersonic jet.** Swayambunathan, V.; Lim, E.C. (Wayne State Univ., Detroit, MI). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

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Although there have been reports of short C...O contacts in crystals, that have been attributed to C-H...O hydrogen bonds, no conclusive spectroscopic evidence exists concerning the formation of the weak hydrogen bonds. Only some infrared studies in the C-H stretching region have been presented as evidence for the presence of hydrogen bonding involving the C-H bond. The authors report here direct spectroscopic observation of intramolecular C-H...O hydrogen bonds in the CT excited singlet state of methyl 9-anthroate (MA). Most 9-carbonyl substituted anthracenes, including MA, are nonplanar in the ground electronic state (S_0) and planar in the CT excited singlet state (S_1).

5638 (SERI/CP—233-2959, pp 218) **Primary rates, radical yields and back-reactions in oxidation of triplet zinc tetraphenylporphine by quinones.** Linschitz, H.; Bera, S.C.; Periasamy, N.; Levy, J.M. (Brandeis Univ., Waltham, MA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Excited-state electron-transfer processes may lead either to separation of high-energy radical products or immediate quenching of the primary reaction complex. One of the main goals of work is the clarification of factors which govern the competition between these processes and thereby control the efficiency of the primary energy-storing process. The oxidation of triplet ZnTPP is a reaction which is well-suited for such study, since the molar extinction coefficients of both the triplet and its radical cation are known, and both species may be conveniently observed at a single wavelength, by flash photolysis. Reaction rates, radical yields and radical recombination rates have been obtained for the oxidation of triplet ZnTPP by seven quinones, in benzene acetonitrile and N-methyl formamide, and in benzene-acetonitrile mixtures.

5639 (SERI/CP—233-2959, pp 219) **EPR and optical absorption evidence for two distinct porphyrin triplet states in linked porphyrin-quinone molecules.** McIntosh, A.R.; Bolton, J.R.; Ho, T.F.; Weedon, A.C.; Connolly, J.S.; Marsh, K.L.; Cook, D.R. (Univ. of Western Ontario, London). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The authors have carried out a spectroscopic and photophysical study of porphyrin triplet states in a series of meso-tetratolylporphyrins to which certain molecular moieties have been attached covalently via diamide linkages, the two amides being separated by n methylene groups (n = 2,3,4). The attached end groups include methyl-p-benzo-quinone, the corresponding hydroquinone and dimethyloxybenzene. Over the temperature range of 80 K to 300 K, laser flash photolysis experiments with time-resolved detection of optical absorption were performed.

5640 (SERI/CP—233-2959, pp 220) **Competitive photocorrosion processes in semiconductor colloids.** Meisel, D.; Mills, G.; Matheson, M.S. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Photoexcitation of semiconductor colloids, resulting in electron-hole pairs is followed by electron injection to or from the colloid. The net charge thus created in the semiconductor will react with the colloid material itself, unless removed rapidly from the material. This leads to the anodic photocorrosion of sulfide colloids by holes remaining in the material or to cathodic dissolution of metal oxide colloids by injected electrons. These corrosion processes are important, not only in energy conversion systems, but in many catalytic systems as well. The authors have recently initiated a study into the mechanisms controlling these corrosion processes and their consequences. Combining laser flash photolysis with pulse radiolysis techniques, they are studying the detailed mechanism of photocorrosion of sulfide colloids (in particular CdS and As_2S_3) and the reductive dissolution of transition metal oxides (e.g., MnO_2).

5641 (SERI/CP—233-2959, pp 221) **Picosecond studies of electron transfer at semiconductor liquid junctions.** Miller, R.J.D. (Univ. of Rochester, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

A great deal of theoretical interest has focused recently on the dynamics of photoinitiated electron transfer processes at semiconductor liquid interfaces. The various theoretical models, that have been developed, can be roughly classified into two categories: (1) thermalized interfacial minority carrier transfer directly at the semiconductor surface; and (2) hot carrier injection from within the space charge region. The latter category can be broken into classical descriptions of carrier migration in the presence of the space charge field or tunneling processes. The time scale for the dynamics predicted by either model differ by over an order of magnitude and unambiguous experimental verification of the transfer mechanism(s) seems most possible in the time domain. To date, experimental studies have not been able to address the electron transfer dynamics on the correct time scale to directly study this process. The authors have developed two new sub-picosecond optical techniques (100 femtosecond time resolution) which enable the direct observation of the minority carrier injection dynamics. The experiments are based on picosecond holographic methods and electro-optic sampling. A discussion of the experimental methods will be presented along with preliminary results on n-TiO_2 and n-GaAs semiconductor systems. In addition, optical pulse shaping techniques used to develop 100 femtosecond pulses, essential to the research, will be presented.

5642 (SERI/CP—233-2959, pp 222) **Stability of metalloporphyrin π-radical anions and cations in aqueous solutions.** Neta, P.; Richoux, M.C.; Harriman, A. (National Bureau of Standards, Gaithersburg, MD). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

One-electron reduction or oxidation of several water soluble metalloporphyrins (MP) yields the π-radical anions or cations. MP + e^- → MP/sup .-/ MP - e^- → MP/sup .+/. The lifetimes of these radicals and the nature of their final products were studied by pulse and steady-state radiolysis techniques. The lifetimes of the radicals were found to vary from milliseconds to hours, depending on the porphyrin ring substituents and on the central metal ion. Metalloporphyrin radical cations may oxidize water to oxygen on the surface of ruthenium oxide catalyst. Rate constants for such reactions also were monitored by pulse radiolysis.

5643 (SERI/CP—233-2959, pp 223) **Kinetic model for hot electron transfer from superlattice photoelectrodes.** Nozik, A.J.; Turner, J.A.; Thacker, B. 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

A kinetic model has been developed that quantitatively describes electron transfer from photoexcited superlattice (SL) electrodes into liquid solutions. The model permits electron transfer from all quantum levels in the last quantum well of the SL electrode, as well as from surface states. It is assumed that for any level above the lowest one, electrons are either injected into solution or they thermalize down the next level. For the lowest level, electrons either are injected into solution or are trapped in surface states; surface state electrons either recombine with holes or are transferred into solution. The model also takes into account band movement through surface state charging. Bulk transport through the SL is treated by the Gaertner theory using an effective diffusion length perpendicular to the layers. The model generates computer simulation of the photocurrent action spectra and current-voltage characteristics of the SL electrodes. The theoretical model was tested against experimental data from a GaAs/GaAs/sub 0.5/P/sub 0.5/ strained layer superlattice with 250 A wells and 250 A barriers. The photocurrent spectra were determined as a function of electrolyte redox potential, SL electrode potential, and acceptor concentration.

5644 (SERI/CP—233-2959, pp 224) **Effect of dimensionality on spectral emission curves.** Casti, T.E.; Otvos, J.W. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Use of the Wien displacement law to determine the position of the solar emission maximum is dependent upon the units chosen for irradiance and upon measuring methods. Examples are given of four emission spectra that are equally valid representations of a 6000k black body. All integrated quantities are identical; only the differential forms are affected.

5645 (SERI/CP—233-2959, pp 225) **Singlet oxygen reactions in spread monolayers. A comparison of product yield and effects of reaction on surface parameters.** Leone, A.; Patterson, L.K. (Univ. of Notre Dame, IN). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Using high pressure liquid radiochromatography, the authors have directly determined quantum yields of photoreactions in spread monolayers and their dependence on such parameters as surface pressure, subphase composition and irradiation time. Singlet oxygen attack, investigated in this study, was initiated by photoexcitation of pheophytin incorporated into monolayers of cholesterol and of the singly unsaturated lipid, palmityloleylphosphatidyl choline. The products of singlet oxygen reaction, especially in cholesterol, are unique and allow ready identification of product formation with singlet oxygen reaction. Literature techniques were used for product separation; and accurate measurements of product at the nanomolar level were obtained. Quantum yields of photoproduct were found to be about 2-5 x 10^{-3}. At pressures above the phase transition for the pheophytin-cholesterol system, the yield dropped. However, the yield was enhanced with increasing pressure in pheophytin-lipid systems. Both behaviors may be explained by reorganization of monolayer components upon compression. Effects with D_2O were also obtained in both systems. While correlation between product yield and pressure behavior were observed in lipid systems, such relationship was found not straightforward in cholesterol monolayers.

5646 (SERI/CP—233-2959, pp 226) **Photochemical study of the binding of counterions to polyelectrolytes.** Sassoon, R.E.; Todesco, R.V.; Hug, G.L. (Univ. of Notre Dame, IN). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The binding of counterions to polyelectrolytes was investigated to gather more data on retardation of back electron transfer by polyelectrolytes in photochemical systems. Equations were developed to describe the emission decay law of a polyion-linked chromophore among quencher counterions. Laser flash photolysis studies were made of a $Ru(bpy)_3^{2+}$, where bpy = bipyridines, chromophore linked to a polyelectrolyte in the presence of quenchers including $Fe(CN)_6^{3-}$, $Ni(CN)_4^{2-}$, $IrCl_6^{2-}$, and $PtCl_4^{2-}$. Steady-state luminescence studies were conducted to obtain the chromophore emission intensity as a function of the quencher concentration.

5647 (SERI/CP—233-2959, pp 227) **Evidence of singlet state reactivity of chlorophyll in a particulate model system.** Seely, G.R. (Battelle-Kettering Lab., Yellow Springs, OH). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The investigation of the photochemistry of chlorophyll in a model system in which it is adsorbed to particles of polyethylene, swollen with tetradecane, is undertaken in the hope of finding evidence of excited singlet state reactivity in the confines of the particle surface region. Determination that an observed set of permanent products results from reaction initiated by a singlet excited state is not easy, unless the quantum yield is very high, because it is necessary to eliminate or quantify a number of alternative possibilities. Nevertheless, energetic and kinetic arguments can be advanced that some of the reactions the authors have seen are initiated by a chlorophyll singlet excited state, or by ion pairs derived from it. Three examples are given.

5648 (SERI/CP—233-2959, pp 228) **Synthetic potential catalysts designed to mimic the bicycle-pedal double cis-trans isomerization of retinal in bacteriorhodopsin.** Seltzer, S. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Recently, the authors have shown (JACS 107, 5523 (1985)) that resting dark-adapted bacteriorhodopsin (bR/sup DA/) continues to cis-trans isomerize its covalently bonded retinal, in the dark. This involves a concerted cis-trans isomerization about two adjacent double bonds which appears to take place by a bicycle-pedal-motion. An enzyme catalyzed double cis-trans isomerization reported previously from this laboratory (JACS 106, 3046 (1984)), also proceeds by bicycle-pedal-motion and operates by a nucleophilic catalysis mechanism. In the bacteriorhodopsin system, catalysis by a nucleophilic amino acid side chain of the protein is a likelihood. Aspartate-212 is here proposed as that nucleophilic catalyst. In the alpha-helical structure of bR in the membrane, asp-212 lies almost directly above lysine-216, the amino acid used by the protein to bind retinal through a protonated Schiff base. The likelihood of the aspartate carboxyl acting as the nucleophile is being tested with the use of syn and anti 2-aza-6-carboxymethylbicyclo[2.2.2]octane, designed to provide the amino and carboxyl functionalities, in proper stereoorientation, to mimic the active site. A progress report on the synthesis of these potential catalysts, their combination with retinal, and their relationship and similarities to bacteriorhodopsin is given.

5649 (SERI/CP—233-2959, pp 229) **Laser-induced temperature jump coulostatics - a method for investigation of fast heterogeneous electron transfer.** Feldberg, S.W.; Goldman, M.; Smalley, J.F. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

A method has been developed to investigate fast heterogeneous electron transfer. The method is based on the change in temperature of an electrode effecting the open-circuit potential. Electron transfer occurs between the electrode and a redox couple. The method is termed coulostatic because no charge is passed through an external circuit.

5650 (SERI/CP—233-2959, pp 230) **Picosecond-resolved ground-state recovery of rhodamine 640 on ZnO: evidence for ultrafast nonradiative dye-surface excitation transfer.** Anfinrud, P.A.; Causgrove, T.P.; Struve, W.S. (Ames Lab., IA). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Dyes adsorbed at low coverage on wide-bandgap semiconductors like ZnO typically exhibit much faster fluorescence decay behavior than on fused quartz. The channel responsible for this accelerated decay on semiconductors is widely believed to be electron injection from the photoexcited dye into the space-charge region. Since photocurrent efficiencies of liquid-junction solar cells with dye-coated single-crystal electrodes are generally small, the possibility exists that dye electronic excitation may decay nonradiatively into semiconductor modes. To differentiate between these decay mechanisms, the authors have done optical pump-probe measurements of ground-state recovery dynamics of rhodamine 640 adsorbed on fused quartz and on ZnO at submonolayer coverages. Samples were pumped and probed at 589 nm using synchronously pumped dye laser beams modulated at 6.5 and 0.5 MHz respectively. Effects of dye photooxidation on the measured photobleaching transients were minimized by simultaneously translating and rotating the sample to provide a surface-filling raster. The photobleaching transient signal was monitored at 7.0 MHz using a Drake R-7A radio receiver for single-sideband detection.

5651 (SERI/CP—233-2959, pp 231) **Linear prediction spectral analysis with improved resolution and sensitivity.** Tang, J.; Norris, J.R. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Despite the computation efficiency of the Fast Fourier transformation (FFT) and its wide usage, there are some performance limitations such as sinc wiggling artifacts of truncated signals and phase distortion problems due to spectrometer deadtime. To overcome these difficulties of FFT, the authors have developed an alternative using linear prediction (LP). With the LP method, the missing parts of the signal can be reconstructed and thus the artifacts of FFT can be avoided. In addition to resolution enhancement, significant noise reduction can be achieved with no loss of resolution as a result of the coherent averaging property of the LP filtering. Unlike the maximum entropy method (MEM) which only yields a power spectrum, the spectrum obtained by the LP method contains phase information. In addition, the extent of sensitivity improvement of the LP method is significantly superior to either MEM or FFT using apodization. They have applied this new method to magnetic spectroscopy for resolution and sensitivity improvement. With the LP technique, the truncation artifacts of FFT incurred in two dimensional NMR and the phase distortion in electron spin echo measurements can be minimized. One can also improve sensitivity by about one order of magnitude which corresponds to a saving of experimental time by about one order of magnitude which corresponds to a saving of experimental time by about two orders of magnitude. The sensitivity enhancement of this method are very important for many spectroscopic studies in vivo systems.

5652 (SERI/CP—233-2959, pp 232) **Electrocyclic reactions of radical cations studied by low temperature EPR and optical spectroscopy.** Thurnauer, M.C.; Brauer, B.E. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Radical ion intermediates play an important role in several chemical processes such as photochemical energy conversion, radiation chemistry and polymerization. Yet there has been little information available about structure and reactivity of these species, particularly in condensed media. Recently, there has been a series of studies of radical cations formed by radiolysis of solid and liquid solutions, providing new insights into the properties of these species. The techniques of λ irradiation of hydrocarbon solutes in frozen Freon matrices to generate radical cations for study by EPR and optical spectroscopies has been particularly useful. The authors are using these methods to investigate electrocyclic reactions of radical cations. Initially, the authors are examining the rearrangement of the substituted cyclobutene radical cation, 1,2-diphenyl-3,3,4,4-tetramethylcyclobutene (CB^+.) to form the substituted butadiene radical cation, 3,4-diphenyl-2,5-dimethyl-2,4-hexadiene (BD^+). It is convenient to study ring-opening in this system (CB^+) since they have available both the ring-closed and ring-opened parent neutral molecules. Therefore, they can produce the cations from each molecule independently.

5653 (SERI/CP—233-2959, pp 233) **Ultrafast carotenoid to chlorophyll energy transfer in photosynthesis. Studies of biomimetic models and bacterial antenna proteins.** Wasielewski, M.R.; Gust, D.; Moore, T.A.; Frank, H.A.; Liddell, P.A. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Carotenoids serve as light-harvesting pigments and as photoprotective agents in photosynthetic organisms. Their role as antenna pigments involves absorption of photons in the blue-green spectral region followed by highly efficient singlet-singlet energy transfer to a neighboring chlorophyll. The dependence of both the rate and mechanism of energy transfer on carotenoid-chlorophyll distance and orientation in photosynthetic organisms and in model systems is unknown. In order to address these questions the authors have measured directly both the rate and efficiency of singlet-singlet energy transfer from a carotenoid covalently linked to pyropheophorbide a, PPheo a, in two model compounds and from carotenoids to bacteriochlorophyll a in a series of pure bacterial antenna proteins using picosecond transient absorption spectroscopy. In one model compound the pi systems of the carotenoid and PPheo a possess a maximum edge-to-edge distance of 5 A, while the other model this distance is only 2 A.

5654 (SERI/CP—233-2959, pp 234) **Light induced intramolecular electron transfer in linked porphyrin-quinone compounds.** Bolton, J.R.; Schmidt, J.A.; Ho, T.F.; Weedon, A.C. (Univ. of Western Ontario, London). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

In recent years the authors have prepared a number of compounds consisting tetra-aryl porphyrins linked to quinones as models of the photosynthetic reaction center, and have studied their intramolecular light induced electron transfer reaction. In the systems examined the electron donor and light absorber (the porphyrin) has been attached to the electron acceptor (the quinone) by a variety of linkages. These include flexible polymethylene chains and rigid [2:2:2]-bicyclo-octane rings. In addition, they have prepared a compound consisting of a tetra-aryl porphyrin attached to a cyclodextrin ring; the latter is a cylindrically shaped molecule made up of 7 glucose units which is capable of complexing electron acceptors into its interior. The efficiency of intramolecular light induced electron transfer in these compounds has been examined by epr, fluorescence and flash photolysis and the results have been published. They now report results obtained with some new linked donor-acceptor compounds consisting of a porphyrin linked to a quinone by an amide group, and of a porphyrin linked to a quinone by phenyl and biphenyl groups; the light induced electron transfer properties of these compounds have been examined by flash photolysis and steady state and time resolved fluorescence spectroscopy. The effect of the nature of the linkage and of the supporting medium upon the electron transfer reaction has been examined.

5655 (SERI/CP—233-2959, pp 235) **Mechanistic studies of photoinduced C-C bond cleavage in aminoalcohols.** Xiaohong, C.; Lee, L.Y.C.; Whitten, D.G. (Univ. of Rochester, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The authors have found that certain aminoketones and aminoalcohols (azapinacols) undergo carbon-carbon bond cleavage upon activation via electron transfer oxidation with an excited acceptor. For both the ketones and the alcohols a prominent photoproduct is the aldehyde. Typical acceptors used in these reactions include various polypyridyl ruthenium (II) complexes and thioindigo. For the ruthenium (II) complexes quantum efficiencies are in the range 0.1-0.2 for rigorously degassed solutions and up to 0.7 for oxygenated samples. The one-electron reduced ruthenium (II) complex is observed as both a transient and permanent photoproduct in the reaction; however the stoichiometric relationship between aldehyde produced and metal complex ions reduced is much greater than one. Transient photolysis shows that the initially-formed reduced ruthenium complex is oxidized in a bimolecular process with $k=3.8 \times 10^7\ m^{-1}\ S^{-1}$ and that there is some net reduced complex which is not reoxidized. For thioindigo as the excited donor the efficiencies of both dye reduction and aldehyde production are high and comparable; here again the efficiencies of aldehyde production are higher in the presence of oxygen than in rigorously degassed solutions; this can be attributed, at least in part, to the role of oxygen in regenerating the light-absorbing acceptor. Results obtained to date are consistent with at least two mechanisms for fragmentation of the radical cation formed by oxidation of the amino alcohol.

5656 (SERI/CP—233-2959, pp 236) **ESR Studies of photoreduction in colloidal TiO_2 solutions.** Wang, J.T.; Williams, F. (Univ. of Tennessee, Knoxville). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Photoinduced redox reactions at semiconductor colloids have been studied by many different techniques. However, the prior use of ESR spectroscopy to detect radical intermediates in these reactions appear to have been limited to the indirect method of spin trapping. As a first step, the authors have now used the ESR technique to study the generation of the well-known reduced forms of MV^{2+} (1,1'-dimethyl-4,4'-bipyridinium dication) and TCNQ (tetracyanoquinodimethane) in colloidal solutions. Methanol solutions of TiO_2 colloids containing these substrates have been continuously illuminated in the ESR cavity using the filtered (C.S. No. 7-54) output ($\lambda < 400$ nm) from a 450-W xenon lamp.

5657 (SERI/CP—233-2959, pp 237) **Transient spectroscopy of binuclear metal complexes.** Winkler, J.R. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

The transient spectroscopy of binuclear metal complexes is presented. Dimers of Rh(I) and Ir(I), $[Rh_2(TMB)_4]^{2+}$ and $[Ir(\mu\text{-}pz)(COD)]_2$ (TMB = 2,5-dimethyl-2,5-diisocyanohexane, pz = pyrazolyl, COD = 1,5-cyclooctadiene), were investigated in the excited state. In the excited state there exist metal-metal bonds. The spectra and lifetimes of the singlet and triplet excited states were measured. Fluorescence quenching was found to happen because of intersystem crossing rather than electron transfer.

5658 (SLU-IVL—173) **Scaling of fuel chips. Sawdust and bark.** Nylinder, M.; Toermarck, J. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1986. 98p. (In Swedish). NTIS (US Sales Only), PC A05. Order Number DE88750410/JAW.

The reason is, to describe the properties of the energy assortments and to develop measuring methods. In determination of fuel value the number of moisture content measurements are conclusive in reducing the mean deviation to a minimum. Determination of calorific value (Wsub(k)) and ash content is of minor importance. The following random sampling can be conceivable when determining the fuel value; Ash content and calorific value (Wsub(k)) determined a few times per season by a few samples per assortment. Moisture content, for the large assortments, can be determined according to the following recommendation implying a mean deviation below 1 percent. For deliveries over 50 truck loads, 2 moisture content samples are taken from 25 percent of the truck loads, however at least 50 and not exceeding 75 loads. For deliveries between 4-50 truck loads two moisture content samples are taken per load. For deliveries between 1-3 truck loads five samples are taken per load. In this study it is also indicated that during the measuring period the most frequent values for wood fuel to Vaexjoe energy plant have been the folloing: moisture content46-50 percent, energy value green weight= 2.30-2.49 MWh/ton green, energy value per ton dry matter= 4.70-4.79 MWh/ton TS, energy value per cubic unit= 0.70-0.79 MWh/m/sub3/s, green bulk density= 320-339.9 green weight in kg/m/sup3/s, basic bulk density= 150-169.9 kg TS/m/sup3/s. Approximate formulas ought to be applied. If the ash content shall be included in these formulas, the applied Wsub(a)-value must be connected with a given ash content. (authors).

5659 (STEV—1985-R1) **Study of a biomass liquefaction test facility. Direct liquefaction of wood and peat for production of petroleum fuel substitutes.** Kjellstroem, B. (ed.). (Statens Energiverk, Stockholm (Sweden)). 1985. 37p. NTIS (US Sales Only), PC A03. Order Number DE88750409/JAW.

Canada, Finland, Sweden and the USA have decided to make a joint study of biomass liquefaction through the International Energy Agency (IEA) as a preparation for a possible cooperative project involving design, construction and operation of a biomass liquefaction test facility. The study included a review of process concepts studied in the four countries. Comparative tests were carried out where the same feedstock was used in the experimental liquefaction facilities operated in these countries. Liquid products from liquefaction experiments were analyzed and characterized. Tests on upgrading of the raw biomass oil to gasoline-like products were carried out. A detailed techno-economic evaluation was carried out for six processes. The result of the study indicate that direct liquefaction of biomass can be used to produce liquid boiler fuels with an energy efficiency of 50 - 60 percent. Flash pyrolysis at about atmospheric pressure appears as the most economic process for production of boiler fuels. The product may be competitive with petroleum fuel at the present price level if the cost of the feedstock does not exceed 1.5 USD/GJ. In Sweden and Finland oil price must increase by about 50 percent if boiler fuel from wood liquefaction shall be competitive with petroleum fuel. Up-grading of the raw biomass oil to gasoline-like products appears possible, although much less experimental work has been done in this field. It is not possible at present to judge whether flash pyrolysis at atmospheric pressure or high pressure liquefaction in a liquid phase is the most economic route to this type of product. Estimated production costs for a feedstock cost of 3.5 USD/GJ are twice as high as the present import price for gasoline. (authors).

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 5671

5660 (SAND—87-7015) **A comparative assessment of photovoltaics, handpumps and diesels for rural water supply.** Cabraal, A.; Seiss, A.; Slominski, L.; Buresch, M.; Kenna, J. (Meridian Corp., Alexandria, VA (USA); I. T. Power, Inc., Washington, DC (USA)). Nov 1987. Contract AC04-76DP00789. 170p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88002814/JAW.

This report is an economic and technical assessment of photovoltaics (PV), handpumps and diesels for water supplies in rural areas of developing countries. The requirements and problems associated with rural water supply (RWS) systems are examined within the context of regional resource conditions, water needs, and cost and performance of the technology. This study found that PV RWS systems can supply water more economically than handpumps or diesels for villages of moderate size where the water table depths are 20 to 40 m. On the average, the cost-effective village size ranges from about 300 to 2000 persons per village for PV RWS systems. Contrary to popular belief, in many cases, on a per capita basis even the initial cost of PV systems is equal to and even less than that of comparable handpump RWS systems. Numerous sensitivity analyses were conducted and are provided to aid water supply planners to decide whether PV systems would be appropriate for their specific needs. Preliminary specifications and market

estimates were also compiled to aid PV manufacturers develop technology appropriate for the rural water supply market. 34 refs., 41 figs.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 5672, 5673

5661 **(AD-A—184188/1/XAB) Design of a condenser-boiler for a binary mercury-organic Rankine-cycle solar-dynamic space-power system. Final report.** Cotton, R.M. (Army Military Personnel Center, Alexandria, VA (USA)). 15 May 1987. 90p. NTIS, PC A05/MF A01.

A theoretical design was performed for the condenser/boiler of a space-based solar-dynamic power system. The base system is a binary Rankine cycle with mercury and toluene, as the working fluids. System output is 75 KWe with a combined efficiency of 41.1%. Design goals were to develop the most-reliable, mass-efficient unit possible for delivery to a space station. The design sized the unit based on toluene properties and used a computer generated heat balance to thermodynamically match the two fluids. Molybdenum was chosen as the material due to mass effectiveness in heat transfer, strength, and resistance to mercury corrosion. The unit transfers 137.46 kilowatts of thermal power and can operate at varying mass-flow rates. Effectiveness in heat transfer is 0.96 and mass performance is 0.016 kg/KWth transferred. The design keyed on using only existing technologies, and the results call for no new developments.

5662 **(BMFT-FB-T—86-210) Solar-process heat generation plant 1 ton steam/H at 190deg. Final report.** Muehl, E.; Niggl, V. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); M.A.N. Technologie G.m.b.H., Muenchen (Germany, F.R.)). Dec 1986. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750989/JAW.

In 1984/85, the Helioman 3/32 collector with twin-axis sun tracking was used for the first time in Pisticci/Southern Italy for generating process heat on an industrial scale. The joint German-Italian project of AGIP NUCLEARE and M.A.N.-Neue Technologie generates with 54 modules for ANIC FIBRE 1 t/h sightly superheated steam at a temperature of 180degC. In contrast to earlier installations which were used for the generation of electricity and therefore required a fixed final temperature of the thermal oil, it was possible in the case of this installation to test a new operating principle. With considerably reduced control requirements, a concept was implemented with constant field mass flow and therefore variable temperature spread and field outlet temperatures. With 3 refs., 2 tabs., 11 figs..

5663 **(N—87-27185) Preliminary design and cost of a 1-megawatt solar-pumped iodide laser space-to-space transmission station.** Deyoung, R.J.; Walker, G.H.; Williams, M.D.; Schuster, G.L.; Conway, E.J. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Sep 1987. 21p. (NASA-TM—4002; L—16308; NAS—1.15:4002). NTIS, PC A02/MF A01.

A preliminary conceptual design of a space-based solar pumped iodide laser emitting 1 megawatt of laser power for space-to-space power transmission is described. A near parabolic solar collector focuses sunlight onto the t-C4F9I (perfluoro-t butyl iodide) lasant within a transverse flow optical cavity. Using waste heat, a thermal system was designed to supply compressor and auxiliary power. System components were designed with weight and cost estimates assigned. Although cost is very approximate, the cost comparison of individual system components leads to valuable insights for future research. In particular, it was found that laser efficiency was not a dominant cost or weight factor, the dominant factor being the laser cavity and laser transmission optics. The manufacturing cost was approx. two thirds of the total cost with transportation to orbit the remainder. The flowing nonrenewable lasant comprised 20% of the total life cycle cost of the system and thus was not a major cost factor. The station mass was 92,000 kg without lasant, requiring approx. four shuttle flights to low Earth orbit where an orbital transfer vehicle will transport it to the final altitude of 6378 km.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 5662

5664 **(BMFT-FB-T—86-202) Central solar heating plants with seasonal storage. Final report.** Krischel, D.; Kiupel, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). Dec 1986. 134p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750984/JAW.

In the present paper which had been prepared within the framework of Task VII of the IEA programme 'Solar Heating and Cooling' several possibilities were investigated relating to the economic utilization of solar energy using large-volume (some thousand m/sup 3/) long-term storage units. The operating behaviour of various storage unit-collector combinations with and without heat pumps has been simulated by means of computer programmes taking the national climate conditions into consideration. The simulated systems have been evaluated from the cost aspect. The computer code MINSUN used for the IEA Task VII turned out to be suitable for the tasks of this study. The most efficient system from the economic point of view is one with a ground basin storage unit thermally insulated only at its top and combined with an absorber field and a heat pump between storage unit and thermal load. When compared with conventional energy resources it turned out that none of the storage systems was competitive. Their prices are three to four times to high. The cost-efficiency increases with the size of the storage unit. The environmental compatibility of the solar systems is in any case higher than that of conventional systems. With 32 refs., 8 tabs., 41 figs..

5665 **(EUR—9908) Solar dousers with a seasonal effect applied to passive solar architecture: Final report.** Scamoni, F.; Flisi, U.; Monaco, U. (Montedison Polimeri S.p.A., Milan (Italy)). 1985. 100p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900131/JAW.

This research was undertaken with the aim of verifying the validity of controlling the sunlight admission into dwellings by using PMMA prismatic sheets as solar dousers. The mechanism by which solar radiation is admitted or rejected is that of total internal reflection. The optical properties of the prismatic sheets have been theoretically calculated with a computerized calculation program and experimentally investigated in different ways with light transmission apparatuses, operating with both artificial and natural light. Light transmittance data were thus obtained under different angles, and the experimental curves gave the same trend as the theoretical ones. The practical performance of the solar dousers assembled in a real-size architectural component, has been tested by means of test cells instrumented for measuring the effect of sunlight admission. Smaller test boxes have also been built in order to compare the behavior of solar dousers with the shading effect of overhangs. Incident sunlight data and temperature measurements of test cells and boxes were worked out in order to obtain the daily mean transmittance of the solar dousers in comparison with that of a standard glazing. The results of such an exercise, done at different periods of the reduction of light transmittance, is of the order of 30% in summertime, and decreases to zero in the fall. 19 refs., 44 figs., 3 tabs.

5666 **(INPE—4114-RPE/537) Solid absorbtion cycle solar energy: refrigeratores.** Anhalt, J.; Gill, W. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Feb 1987. 16p. (CONF-8605211—). NTIS, PC A02/MF A01.

From 2. Latin American congress on heat and mass transfer; Sao Paulo, Brazil (12 May 1986).

There has been recent worldwide interest in the development of solar thermal powered refrigerators utilizing a solid absorber system. Three proposed absorber-working fluid combinations are examined: zeolite/water; calcium chloride/ammonia; and activated charcoal/alcohol. Experiments with the zeolite/water system are also discussed. It is concluded that the proper activation of the solid absorbent, heat transfer in the solar collector, and the circuit

design have the greatest influence on the maximum energy conversion efficiency obtainable.

5667 **(NEI-DK—49) Solar heating systems in public buildings - demonstration plant. One years measurements of a 18 m/sup 2/ solar heating system for water heating in a municipal equipment store.** Lange, M. (Teknologisk Inst., Taastrup (Denmark). Afd. for Varme-og Installationsteknik). May 1987. 62p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750386/JAW.

In the municipality of Roedovre, 20 km west of Copenhagen, an 18 m/sup 2/ solar water heating system has been installed at a building for municipal employers working with maintenance of roads, snow clearing etc. The solar collector consists of 9 prefabricated elements, each of 2 m/sup 2/ size. The system is designed as a traditional preheating system, where the solar storage tank (1000 liter) is coupled in series with the existing hot water tank. During the summer period while there is no space heating demand, and the oilfired boiler is shut off the auxiliary heating to the solar system is delivered by a 15 kW resistor heating element placed on top of the solar storage tank. The performance of the system has been monitored for one year (1985/1986) and the main results from the measurements are: Total oil saving: 36,500 kWh; Extra electricity consumption: 3,200 kWh; Solar output per year: 432 kWh/m/sup 2/; Solar irradiation: 1,149 kWh/m/sup 2/; Annual system efficiency: 38,6%; Annual solar fraction: 50%; Calculated solar output by the f-chart programme, with measured solar irradiation and hot water consumption: 444 kWh/m/sup 2/. (LN).

5668 (SERI/CP—233-2959, pp 215) **Photocatalysts for waste treatment.** Langford, C.H.; Mak, M.S. (Concordia Univ., Montreal, Quebec). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

A wide range of reactions which lead to the degradation and/or detoxification of refractory waste materials have been reported to be photocatalyzed by zinc oxide, titanium dioxide, or cadmium sulfide based photocatalysts. Zinc oxide has been used in field trials for solar treatment of pesticide wastes in rice paddies. The interesting question for development of these catalysts is the evolution of a system to couple the electron/hole pair formation process specifically to the desired chemistry. The authors begin with the observation, derived from flash photolysis, that recombination can be quite effective in small particles unless a suitable partner for rapid interfacial electron transfer is available. (This point will be illustrated.) With this point in mind, the performance of composite catalysts using reaction initiators in polymer films on titanium dioxide catalysts will be described. For hydrophobic targets, a styrene type film functions to support the reaction partner which scavenges carriers from the semiconductor and to favor the adsorption of the hydrophobic target. The specific case of the dechlorination of PCB's in an oil phase by a catalyst ZnTPP/PVP/TiO is reported.

5669 **Design and control tradeoffs for rockbins in passively solar heated houses with Trombe walls, direct gain and high solar fractions.** Sebald, A.V.; Vered, G. (Univ. of California, San Diego). *Solar Energy;* **39**: No. 4, 267-289(1987). Contract AC04-79AL10891.

Performances of active and passive rockbins are compared in Albuquerque, NM, Santa Maria, CA, and Madison, WI. The basic house is assumed to contain both Trombe wall and direct gain. The Trombe wall and direct gain are assumed to be optimally sized and controlled for each weather zone. It is demonstrated that, provided charging is done from the Trombe wall, rockbins can be used to advantage in reducing the early morning auxiliary energy consumption peak common to passive houses with night setback thermostats. The paper also analyzes performance sensitivity to rockbin configuration (active, radiant slab top down charge, radiant slab bottom up charge), and to control strategies for charging and discharging. Effects of fan energy are included.

5670 **Eliminating peak load auxiliary energy consumption in passive solar residences during winter.** Sebald, A.V.; Munoz, D. (Univ. of California, San Diego). *Solar Energy;* **39**: No. 4, 307-319(1987). Contract AC04-79AL10891.

This study simulation analysis with Albuquerque, NM and Madison, WI weather data to address the following four questions: (1) assuming a properly designed and controlled passive house, how does total electrical auxiliary energy consumption depend on the choice of peak load blackout periods? (2) what comfort penalties arise from properly coping with a variety of peak load blackout periods? (3) where should off-peak energy be introduced into the thermal masses of the house? and (4) what are the effects of imprecise information on short term future weather? Using a combination of linear programming and gradient techniques, the following conclusions are obtained: During the worst days of the heating season, passive solar houses built above ground use a substantial amount of peak backup energy even if they are well designed. Even relatively crude off-peak controls provide reasonable comfort provided the energy is introduced in thermal masses well coupled to the room [e.g. 0.05 m beneath the inside face of the Trombe wall or 0.05 m below the top of the slab floor]. Introducing off-peak energy in thermal masses poorly coupled to the room (e.g. deep in the floor slab) makes proper control very difficult without very accurate weather prediction. Reducing backup use to zero from 7 am to 10 pm requires a doubling of daily backup use in Albuquerque and Madison. Excluding backup for shorter periods (e.g., 5 pm to 9 pm) requires an increase of about 25% in daily backup consumption. Even if off-peak energy is stored at points reasonably well coupled to the room, significant backup and comfort penalties are incurred with erroneous weather forecasts. Even in two adjacent days in Madison, reversing the weather patterns while maintaining the same off peak control strategies resulted in either wasting half the backup energy or severely under heating the house.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 5662

5671 **(DOE/EIA—0174(86)) Solar collector manufacturing: Activity 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 13 Oct 1987. 62p. NTIS, PC A04/MF A01 - GPO; 1; GPO Dep. Order Number DE88002154/JAW.

This report presents a statistical profile of the solar collector manufacturing industry during 1986 and the photovoltaic module manufacturing industry during 1985 and 1986. Industry data for both years were obtained concurrently; however, the 1985 solar thermal collector manufacturing data are considered to be incomplete because many manufacturers went out of business after the federal tax credit expired at the end of 1985. These manufacturers could not be located, and their shipment information for 1985 could not be obtained. Data obtained from photovoltaic module manufacturers for 1985 and 1986 are considered complete. 2 figs., 22 tabs.

5672 **(SERI/STR—253-3113) Performance and cost benefits associated with nonimaging secondary concentrators used in point-focus dish solar thermal applications.** O'Gallagher, J.; Winston, R. (Chicago Univ., IL (USA). Enrico Fermi Inst.; Solar Energy Research Inst., Golden, CO (USA)). Sep 1987. Contract AC02-83CH10093. 72p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88001104/JAW.

Using nonimaging secondary concentrators in point-focus applications may permit the development of more cost-effective concentrator systems by either improving performance or reducing costs. Secondaries may also increase design flexibility. The major objective of this study was to develop as complete an understanding as possible of the quantitative performance and cost effects associated with deploying nonimaging secondary concentrators at the focal zone of point-focus solar thermal concentrators. A performance model was developed that uses a Monte Carlo ray-trace procedure to determine the focal plane distribution of a paraboloidal primary as a function of optical parameters. It then calculates the corresponding optimized concentration and thermal efficiency as a function of temperature with and without the secondary. To examine the potential cost benefits associated with secondaries, a preliminary model for the rational optimization of performance versus cost trade-offs was developed. This model suggests a possible 10% to

20% reduction in the cost of delivered energy when secondaries are used. This is a lower limit, and the benefits may even be greater if using a secondary permits the development of inexpensive primary technologies for which the performance would not otherwise be viable. 20 refs., 15 figs., 3 tabs.

5673 **(SERI/STR—253-3212) Mean and peak wind load reduction on heliostats.** Peterka, J.A.; Tan, L.; Bienkiewcz, B.; Cermak, J.E. (Colorado State Univ., Fort Collins (USA)). Sep 1987. Contract AC02-83CH10093. 239p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE87012281/JAW.

This report presents the results of wind-tunnel tests supported through the Solar Energy Research Institute (SERI) by the Office of Solar Thermal Technology of the US Department of Energy as part of the SERI research effort on innovative concentrators. As gravity loads on drive mechanisms are reduced through stretched-membrane technology, the wind-load contribution of the required drive capacity increases in percentage. Reduction of wind loads can provide economy in support structure and heliostat drive. Wind-tunnel tests have been directed at finding methods to reduce wind loads on heliostats. The tests investigated both mean and peak forces, and moments. A significant increase in ability to predict heliostat wind loads and their reduction within a heliostat field was achieved. In addition, a preliminary review of wind loads on parabolic dish collectors was conducted, resulting in a recommended research program for these type collectors. 42 refs., 38 figs., 1 tab.

1420 Heat Storage

5674 **(PB—87-226320/XAB) Extreme-type limit law for a storage process.** Greenwood, P.E.; Hooghiemstra, G. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1986. 29p. (REPT—86-33). NTIS, PC E03/MF A01.

A solar-energy storage model is studied, where input is exponentially distributed but accepted only conditionally. The resulting Markov chain has a stationary distribution depending on two parameters. A limiting distribution is found as one parameter varies and this is used for computation of the asymptotic mean. The limit law may be regarded as a new type of extremal distribution.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 5573

1502 Geology And Hydrology Of Geothermal Systems

5675 **(EGG-M—21387) Reservoir technology research at the Idaho National Engineering Laboratory.** Stiger, S.G.; Renner, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 5p. (CONF-871024—23). NTIS, PC A02. Order Number DE88001532/JAW.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The Idaho National Engineering Laboratory (INEL) has been conducting geothermal reservoir research and testing sponsored by the US Department of Energy (DOE) since 1983. The INEL research program is primarily aimed at the development of reservoir engineering techniques for fractured geothermal reservoirs. Numerical methods have been developed which allow the simulation of fluid flow and heat transfer in complex fractured reservoirs. Sensitivity studies have illustrated the importance of incorporating the influence of fractures in reservoir simulations. Related efforts include fracture characterization, geochemical reaction kinetics and field testing.

1503 Geothermal Exploration And Exploration Technology

5676 **(SAND—87-2593C) High temperature electronics application in well logging.** Traeger, R.K.; Lysne, P.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-871006—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001677/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Some limitations, problems, and needs are briefly reviewed for neutron logging tools used in high-temperature geothermal environments. (ACR)

1508 Geothermal Power Plants

5677 **(EGG-M—38486) Zeotropic mixtures of halocarbons as working fluids in binary geothermal power generation cycles.** Bliem, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 6p. (CONF-870804—45). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001531/JAW.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The performance of Rankine cycle binary systems for geothermal power generation using a hydrothermal resource has been investigated. To date, in addition to many pure fluids, mixtures of Paraffin-type hydrocarbons and water-ammonia mixtures have been investigated. This paper gives the results of consideration of mixtures of halocarbons as working fluids in these power cycles. The performance of mixtures of Refrigerant-114 (R-114) and Refrigerant-22 (R-22) in combinations from pure R-114 to pure R-22 was calculated for such cycles. Various alternatives were considered: (1) minimum geofluid outlet temperature constraint/no constraint, (2) dry turbine expansion/expansion through vapor dome, and (3) use of turbine exhaust gas recuperator/no recuperator. Results of the study indicate that the halocarbon mixtures are at least as good as the hydrocarbon mixtures previously analyzed for a 360 F resource. The magnitude of the net geofluid effectiveness (net energy produced per unit mass geofluid flow) for the R-114/R-22 mixtures is the same as for the best hydrocarbon mixture previously analyzed. The percentage improvement in effectiveness in using mixtures over using the pure fluids as working fluids is comparable for both classes of working fluids.

5678 **(EPRI-AP—5240-SR) Heber binary-cycle geothermal demonstration power plant: Startup and low-power testing: Special report.** Berning, J.; Bigger, J.E.; Fishbaugher, J. (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 213p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920077/JAW.

In 1974 the geothermal industry recognized the need for binary cycle technology in the development of moderate temperature geothermal resources. The electric utilities further expressed a need to demonstrate the technology on a scale representative of commercial operation in order to resolve issues of performance cost and environmental acceptability, and to confirm the maturity of the technology. In response to the needs, EPRI conducted feasibility studies and a series of field experiments intended to culminate with the construction and demonstration of a nominal 50 MWe binary cycle power plant in cooperation with other interested organizations. The early work by EPRI, the Department of Energy and the San Diego Gas and Electric Company led to the formation of the present multi-sponsored project in late 1980. Construction of the demonstration plant was completed in June 1985 at the Heber geothermal field in the Imperial Valley of Southern California. The plant is rated at 46 MWe and converts the thermal energy from 360 F (182 C) geothermal fluid to electricity. Start-up of the plant was completed in December 1985 and the first extended run at low power was completed in June 1986. The results from this run and other tests associated with the plant and the geothermal production facilities during this period are contained in this report. During this period, the brine supply was lower than expected and the reinjec-

tion pressure higher than expected. The power cycle performed essentially as projected for the load levels at which the plant was tested.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 5675

5679 (EUR—10543) Solution of problems of total or partial circulation loss in geothermal drilling: Final report. Chatard, M. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). 1986. 70p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900235/JAW.

The aim of the project was to design and develop a system for plugging up macrofissures or even fractures that are sometimes encountered in non-sedimentary formations and that cannot be plugged up with conventional products. An effort was made to create a netting having the following properties: (1) flexible enough to be folded in a container, so that it could be included in a conventional drill string and be run into a well without being damaged; (2) fine enough to be able to be plugged up by plugging agents on the market; (3) stout enough to be able to withstand pressures appearing during its spreading out and its plugging action; and (4) capable of assuming the shape of the profile of the well and of being at least partially spread out in the fracture. The wire braiding or sheeting that gives hydraulic pipes their mechanical strength are laid at an angle corresponding to an equilibrium. If the wiring is done with an angle wider than the angle of equilibrium, this decreases the length while increasing the diameter. This phenomenon is the basis of the manufacturing of the system. Likewise, during the changing of shape and up to equilibrium, the meshes of the netting have a known size, so that a judicious choice can be made of the plugging agent or the most appropriate mixture of plugging agents. Make-up tests showed that the actual phenomenon effectively occurred.

5680 (LA-UR—87-3388) Hot dry rock reservoir engineering. Murphy, H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 21p. (CONF-8707127—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001838/JAW.

From NATO advanced study institute of geothermal reservoir engineering; Antalya, Turkey (1 Jul 1987).

The Hot Dry Rock (HDR) concept is a simple one. Two nearly parallel wells are drilled, and hydraulic fractures are then formed to hydraulically connect the wells. Water pumped down the injection well and through the fracture system is heated by contact with the hot rock and rises to the production well. This hot fluid is passed through a heat exchanger at the surface and the extracted heat is used for direct heating or electricity generation. The cooled production fluid is then reinjected, thereby setting up a circulation loop. This paper describes the development and execution of the HDR project at Fenton Hill, New Mexico.

5681 (LBL—24033) Recent geothermal reservoir engineering activities at Lawrence Berkeley Laboratory. Lippmann, M.J.; Bodvarsson, G.S.; Benson, S.M.; Pruess, K. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 10p. (CONF-8710187—1). NTIS, PC A02. Order Number DE88002272/JAW.

From International symposium on the development and exploitation of geothermal resources; Cuernavaca, Mexico (5 Oct 1987).

This paper briefly describes the most recent activities in reservoir engineering for the geothermal group of Lawrence Berkeley Laboratory (LBL). The primary emphasis of the geothermal program of LBL is dedicated to reservoir engineering including theoretical investigations, the development and application of mathematical models, and field studies. The objectives of these activities are to develop and validate methods and instruments which will be utilized in the determination of the parameters of geothermal systems, and the identification and evaluation of the importance of the distinct processes which occur in reservoirs. The ultimate goal of the program is the development of state of the art technologies which characterize geothermal reservoirs and evaluate their productive capacity and longevity.

1520 Geothermal Data And Theory

5682 (NUREG/CR—4645) TOUGH User's Guide. Pruess, K. (Lawrence Berkeley Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Aug 1987. Contract AC03-76SF00098;AC04-76DP00789. 85p. (SAND—867104; LBL—20700). NTIS, PC E05/MF A01 - GPO. Order Number TI88001569/JAW.

Includes 6 sheets of 48x reduction microfiche.

This document contains a technical description of the TOUGH computer program, which was developed at Lawrence Berkeley Laboratory for simulating the coupled transport of water, vapor, air and heat in porous and fractured media. The physical processes taken into account in TOUGH are discussed, and the governing equations actually solved by the simulator are stated in full detail. A brief overview is given of the mathematical and numerical methods, and the code architecture. The report provides detailed instructions for preparing input decks. Code applications are illustrated by means of six sample problems.

17 WIND ENERGY

5683 (RISO-M—2628) Contribution of Risoe National Laboratory to the research development programs of the Danish Ministry of Energy. Status December 1986. Skjerk Christensen, P. (ed.). (Risoe National Lab., Roskilde (Denmark)). Jun 1987. 77p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750382/JAW.

Since 1978 Risoe has been responsible for a number of projects in the research and development programs of the Danish Ministry of Energy. This report gives a review of current and finished projects. All current projects are described briefly, stating status and results obtained, while the results of finished projects are described in more detail. Risoe's contribution to the organization and the administration of the programs is mentioned. Finally a list of references is given. 48 refs.

1701 Availability (climatology)

5684 (RISO-R—544) Meteorology and wind energy department annual progress report 1 January-31 December 1986. Kristensen, L. (ed.). (Risoe National Lab., Roskilde (Denmark)). Apr 1987. 100p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750392/JAW.

The research in the Department of Meteorology and Wind Energy is directed towards two major applications: wind energy and modelling air pollution dispersion. In order to maintain a high level of technical competence within these applications the department has carried out both theoretical and experimental basic studies in the field of meso- and micrometeorology. The subjects range from surface energy balance research of the general spatial and temporal structure of atmospheric turbulence, to wind engineering investigations of dynamic loads on buildings, bridges and other structures. Very important parts of the applied work are the testing and licensing of windmills for the Danish market and providing consultative services for Danish windmill manufacturers. (editor). 22 refs.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 5684, 6072

5685 (FOA-C—20601-E3) Control research in windpower project 506259 control FOA. Final report Stage 1. Ulen, E. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Feb 1986. 12p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750402/JAW.

The report contains a survey over the work that has been performed during the first part of the project mentioned in the title. The result has been shown in more details in separate reports.

5686 **(SAND—87-2461C) Modal testing in the design evaluation of wind turbines.** Lauffer, J.P.; Carne, T.G.; Ashwill, T.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-871062—7). NTIS, PC A02. Order Number DE88002220/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

This paper reviews several techniques which have been used to successfully measure modal parameters for wind turbines. Due to problems in providing low frequency excitation (0.1 to 5.0 Hz), modal testing of moderate-size turbines can be difficult. Several techniques of low frequency excitation have been explored, including impact, wind, step-relaxation, and human input. As one application of these techniques, a prototype turbine was tested and two modal frequencies were found to be very close to integral multiples of the operating speed, which caused a resonant condition. The design was modified to shift these frequencies, and the turbine was retested to confirm the expected changes in the modal frequencies. 8 refs., 16 figs., 1 tab.

5687 **(SERI/TP—217-3243) Preliminary results from the dynamic response testing of the Howden 330-kw HAWT [horizontal-axis wind turbine].** Hock, S.M.; Hausfeld, T.E.; Hampson, G.; Thresher, R.W. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1987. Contract AC02-83CH10093. 10p. (CONF-871062—6). NTIS, PC A02. Order Number DE88001110/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

As part of the Department of Energy (DOE) Cooperative Field Test Program, Southern California Edison (SCE) and the Solar Energy Research Institute (SERI) performed a comprehensive dynamic response test on the 330-kW, horizontal-axis wind turbine (HAWT) manufactured by the James Howden Company. This paper presents a preliminary analysis of some data from the test. The data were analyzed using different statistical approaches. First, the mean turbine operating conditions were analyzed using the method of bins. In addition, azimuth averaging was used to separate the deterministic responses from the stochastic responses. The results presented include comparisons of mean power and load versus wind speed. Deterministic rotor-bending loads are plotted as a function of blade azimuth position. Auto-spectral density plots are also computed for the stochastic portion of the rotor blade root-bending moments to determine their dynamic responses to turbulent wind inputs. 2 refs., 14 figs., 5 tabs.

5688 **(SL—1251.87035.00) Power output measurements of 99 kW Baltic Power with new tilting angle.** (Skibsteknisk Laboratorium, Lyngby (Denmark)). Mar 1987. 11p. (In Danish). Danish Maritime Institute, Library, DK-2800 Lyngby.

Prepared for Energigruppen Baltic Power ApS, Klemensker, Denmark.

Measurements are performed for a 3-bladed horizontal axis wind turbine of the 99 kW Baltic Power type. The measurements comply with the requirements of IEA recommendation no. 1 and include measurements of electric power output from the turbine as a function of the wind velocity. The measurements are performed in the period January 26, 1987 to March 3, 1987. In the measuring period the wind velocities were between 1 and 17 m/s (measured as 10 min. mean values). The turbine starts producing energy at a wind velocity of about 3 m/s, and increases to 90 kW at about 13 m/s, when the stalling starts. The turbine reaches an output of about 103 kW at 16,5 m/s. It is estimated a maximum of about 105 kW is reached at wind velocities between 18 and 20 m/s. The electric efficiency C-p culminates at 8-9 m/s with a maximum value of about 0,35. Based on the measured power output the yearly energy production of the turbine at four stanard sites and at its actual site is calculated. The yearly energy production for the actual site is calculated to 233,5 MWh/year. Furthermore the yerly energy production is calculated for two alternative tower heights, 32 m and 40 m, showing that at the actual site the energy production might be increased with 10,3% and 17,8%, respectively, compared with the present tower height of 24 m. (LN).

5689 **(SL—86833) Design and manufacturing basis for wind turbine rotors.** (Skibsteknisk Laboratorium, Lyngby (Denmark)). Jan 1987. 43p. (In Danish). NTIS (US Sales Only), PC A03. Order Number DE88750375/JAW.

A new CAD-tool has been developed at Danish Maritime Institute's Wind Energy Section for the design and manufacturing of rotor blades for the horizontal-axis type of wind turbine. The CAD-tool constists of two parts: Part A, which is an iterative optimization programme with a high level of flexibility, determines the geometrical shape and tip angle of a rotor blade having the best annual energy output per swept area of the rotor for a given roughness classe and hub height. It is possible to chose either a fixed, maximum generator output or a fixed diameter as criterion for the optimization. The programme uses a data base holding aerodynamical data for a number of wing sections including data for different kinds of air brakes, the latter making it possible to calculate the RPM for the free-running rotor as a function of wind speed and air-brake setting. The second part, part B, produced the necessary material for the workshop, either as tables or as drawings (1:1 or scaled). It is possible to define a given, constant shell-thickness to be subtracted/added to each cross section. Also a finite thickness can be included using one of several available methods in the programme. As a special feature the drawings can be made in a form ready to use in a large milling machine for the manufacture of a wooden plug of the rotor blade.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 5771

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 5888, 5889, 5890, 5891, 5892, 5893, 5894, 5895, 5896, 5897, 5898, 5899, 5902, 5903, 5911, 5912, 5913

5690 **(DOE/MC/21098—2248-Vol.1) Conceptual designs of advanced high-temperature desulfurization processes: Volume 1, Molten carbonate fuel cell power plants: Final report.** Klett, M.G.; Boulay, R.B.; Buchanan, T.L.; Chen, H.T.; Fischer, W.H.; Hirschenhofer, J.H.; Losovsky, M.L.; Underkoffler, V.S. (Gilbert/Commonwealth, Inc., Reading, PA (USA)). Dec 1986. Contract AC21-84MC21098. 339p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE87001075/JAW.

Purpose of this effort is to provide conceptual commercial-scale designs, including engineering, relative cost, and economic information for high-temperature desulfurization processes. The commercial-scale processes were designed as an integral part of a nominal 100-MW(e) power plant. Two types of power plants were considered, a coal gasification molten carbonate fuel cell (MCFC) power plant and an integrated gasification combined-cycle (IGCC) power plant. Three desulfurization processes combined with three different gasification processes were evaluated, for a total of 16 cases for the MCFC power plant. The three desulfurization processes evaluated were: METC's zinc ferrite process, Battelle Pacific Northwest Laboratory's solid-supported molten salt process, and Institute of Gas Technology's mixed metal oxide process. Volume I of this report presents the results for the MCFC power plant.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 5376, 5391, 5393, 5900, 5901, 6428, 6451

5691 **(DOE/BP/16380—2) Impact mitigation and monitoring of the BPA 500 kV Garrison-Taft transmission line: Effects on elk security and hunter opportunity: Annual progress report for 1986.** Thompson, M.J.; Dickson, D.C. (Montana Dept. of Fish, Wildlife and Parks, Helena (USA)). Jun 1987. Contract AI79-84BP16380. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87014303/JAW.

The objectives were: (1) to determine the effectiveness of the mitigation measures employed in the Garrison-Taft Project to minimize impacts on elk; (2) to determine the nature and magnitude

of the Project impacts on elk summer-fall habitat use, distribution, use of security areas, and harvest, with emphasis on the adult male segment of the population; (3) to identify and recommend protection for important elk security areas remaining in areas adjacent to the Project; (4) to assess Project impacts on hunter opportunity and on hunters' perceptions of hunting as related to the transmission line, right-of-way, and road systems; (5) to reduce to the extent possible the net Project impacts on elk and elk hunter opportunity; and (6) to determine appropriate measures for offsetting unmitigated impacts. This involved assessing Project-caused changes along the entire route and comparing these with documented impacts on elk and elk hunting within the study areas.

5692 **(DOE/PC/81008—T9) Direct sorbent injection for combined SO_2/NO/sub x/ removal: Quarterly technical progress report, April-June 1987.** Dowdy, T.E.; Henry, J.M.; Lee, J.J.; Rayfield, M.A.; Smith, J.R.; Qian, X. (Tennessee Univ., Tullahoma (USA). Space Inst.). 1987. Contract AC22-85PC81008. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001620/JAW.

With the growing concern over the emission of sulfur and nitrogen oxides from large scale coal fired boilers and the widely held belief that these emissions are precursors to acidic deposition, there is a growing interest in finding effective means of retrofitting existing boiler plants with SO_2 and NO/sub x/ emission control systems. The project objective is the experimental verification of a low cost system for simultaneous SO_2 and NO/sub x/ control technology. The system selected will be configured to require minimum capital cost and minimum additional space. SO_2 and NO/sub x/ reduction to the maximum degree that is economically attractive is sought. The approach taken is to inject active SO_2 and NO/sub x/ sorbents into a flue gas stream that simulates flue gases from a large scale coal fired boiler. The project will also include mathematical modeling to reduce the data and to extend the results to larger systems. 10 refs., 45 figs., 32 tabs.

5693 (EPRI-CS—5386, pp 4.1-4.12) **Pulse-jet filter manufacturers' survey.** Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920023/JAW.

In Pulse-jet fabric filters for coal-fired utility and industrial boilers; Final report.

Pulse-jet, plenum-pulse, and reverse-jet-pulse are terms used by various manufacturers to describe the method of cleaning used in outside collectors. There is generally more product differentiation with outside collectors than with inside collectors because of the multitude of fabrics that are utilized, the type and pressure of cleaning air recommended, and the size of the overall system. Letters were sent to the manufacturers and distributors of pulse-jet fabric filters requesting information related the study. After the initial responses, follow-up telephone calls yielded sufficient information to delineate the important design and hardware features of most of the major manufacturers of pulse-jet equipment. Summaries of these features are given.

5694 (EPRI-CS—5386, pp 5.1-5.47) **Prominent features of pulse-jet installations.** Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920023/JAW.

In Pulse-jet fabric filters for coal-fired utility and industrial boilers; Final report.

Literature and vendor surveys have revealed a number of pulse-jet units for collection of fly ash from utility boilers, worldwide. In North America, however, only four units have been located: Alberta Power's H.R. Milner Station, TransAlta Utilities Corporation's Wabamun Station, Dayton Power and Light's Longworth Station, and the Cromby Station of Philadelphia Electric. Two of these, Alberta Power's H.R. Milner Station and TransAlta Utilities Corporation's Wabamun Station, are Flakt units located in Canada. by far, the largest of the North American Units is the H.R. Milner Station in Alberta, Canada. Its pulse-jet filter cleans the emissions from a 150-MW boiler whose gas flow rate is 692,400 acfm. The Wabamun Station is about two-thirds the size of Milner, in terms of gas flow rate (about 464,000 acfm). The most important features of these pulse-jet installation are described.

5695 (EPRI-CS—5386, pp C.2-C.29) **Typical specifications for pulse-jet fabric filters for coal-fired boilers (C-E air preheater and environmental elements).** Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920023/JAW.

In Pulse-jet fabric filters for coal-fired utility and industrial boilers; Final report.

Specifications and design standards for a pulse-jet fabric filter dust collector for coal-fired boiler are presented. The dust collector manufacturer, as part of the proposal, shall furnish drawings and other descriptive materials covering the general design, construction and special features of all items furnished including a description of proposed instrumentation and controls. The dust collector design details are the sole responsibility of the vendor. Reliance is placed upon his experience record and knowledge to offer the type of equipment that will be best suited for the specified operating conditions. The dust collector shall be arranged for gas flow through the bags from the outside to inside. Bag cleaning will be by a jet of compressed air through a venturi into each bag. The dust collector cleaning cycle shall be an automatic sequence through each row of bags and may be designed for either on-line or off-line cleaning.

5696 (EPRI-CS—5386, pp D.1-D.145) **Prominent features of domestic and non-domestic pulse-jet fabric filters used on utility and industrial coal-fired boilers.** Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920023/JAW.

In Pulse-jet fabric filters for coal-fired utility and industrial boilers; Final report.

The prominent features of domestic and non-domestic pulse-jet fabric filters used on utility and industrial coal-fired boilers are presented. The data, presented in three tables, are sorted: (1) alphabetically by company name, (2) alphabetically by vendor name, and (3) by descending values of gas flow rate.

5697 (EPRI-CS—5386, pp E.1-E.91) **Prominent features of domestic pulse-jet fabric filters used on utility and industrial coal-fired boilers.** Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920023/JAW.

In Pulse-jet fabric filters for coal-fired utility and industrial boilers; Final report.

The prominent features of domestic pulse-jet fabric filters used on utility and industrial coal-fired boilers are presented. The data, presented in three tables, are sorted: (1) alphabetically by company name, (2) alphatically by vendor name, and (3) by descending values of gas flow rate.

5698 (EPRI-CS—5386, pp F.1-F.59) **Prominent features of non-domestic pulse-jet fabric filters used on utility and industrial coal-fired boilers.** Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920023/JAW.

In Pulse-jet fabric filters for coal-fired utility and industrial boilers; Final report.

The prominent features of non-domestic pulse-jet fabric filters used on utility and industrial coal-fired boilers are presented. The data, presented in three tables, are sorted: (1) alphabetically by company name, (2) alphabetically be vendor name, and (3) by descending values of gas flow rate.

5699 **(EPRI-CS—5476) Evaluation of flue gas desulfurization materials in the mixing zone: R.D. Morrow Sr. Generating Station: Final report.** Koch, G.H.; Kistler, C.; Mirick, W. (Battelle Columbus Labs., OH (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 211p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920066/JAW.

Field studies were performed in the mixing zone of Units 1 and 2 of the R.D. Morrow, Sr. Generating Plant to evaluate the performance of various nonmetallic linings and alloys in actual flue gas desulfurization (FGD) environments. After 18 months of exposure few materials, lining, or alloys have not shown any failure. Of the linings, the borosilicate block did not show any deterioration,

while some vinyl ester and epoxy linings showed only some localized failure. The gunite, fluoroelastomer and fiber reinforced polyester suffered general failure. Of the alloys, the titanium and highly alloyed nickel-base alloys exhibited good resistance to the acidic outlet duct environment. However, the lower alloyed nickel-based alloys and stainless steels suffered considerable weight loss and pitting or crevice corrosion. 17 refs., 120 figs., 16 tabs.

5700 **(EPRI-EA—5011) Field evaluation of instruments for the measurement of unsaturated hydraulic properties of fly ash: Interim report.** Rehm, B.W.; Christel, B.J.; Stolzenburg, T.R.; Nichols, D.G.; Lowery, B.; Andraski, B.J. (RMT, Inc., Madison, WI (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Apr 1987. 169p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE87920357/JAW.

There is a growing demand for data concerning the pore water chemistry and the hydraulic properties of unsaturated porous media (moisture content, pressure potential) for use in geohydrochemical models and to demonstrate compliance with more stringent regulatory guidelines. This report presents the results of an evaluation of the performance of commercially available devices that can provide this data. The evaluated devices included: tensiometers, gypsum blocks, fiberglass cells, neutron probe with steel and aluminum access tubes, ceramic and Teflon porous cup pressure-vacuum pore water samplers and zero-pressure pore water samplers. The equipment was installed in a 30 x 30 x 3.0 meter test cell that was intended to simulate dry fly ash disposal operations. Some of the devices were attached to a data logger that recorded hourly measurements while the rest were measured from several times a week to once a month. Performance data are included.

5701 **(KFK-PEF—17) Simultaneous desulfurization and denitrification of flue gas by electron beam.** Baumann, W.; Jordan, S.; Maetzing, H.; Paur, H.R.; Schikarski, W.; Wiens, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.. Lab. fuer Aerosolphysik und Filtertechnik, LAF). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). May 1987. 322p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751031/JAW.

The simultaneous desulfurization and denitrification by the irradiation with 300 keV electrons in the presence of stoichiometric amounts of ammonia yields removal efficiencies of more than 90%. NO/sub X/-removal efficiencies depend on the absorbed dose, NO/sub X/-concentration and NH/sub 3/-stoichiometry. SO/sub 2/-removal proceeds by thermal and radiation induced mechanisms. The efficiency of the SO/sub 2/-removal process is highest for low temperatures and high NH/sub 3/-stoichiometries. By recycling of scrubbed gas into the reaction chamber (multiple irradiation) the efficiency of the process is increased by 50%. The product aerosol has mass median diameters of <1 μm. The chemical composition of the product is a function of dose and of the relative humidity of the flue gas. The filtration of the product is possible by using additives for conditioning the filter bags. By numerical simulation of the gas phase reaction mechanism removal efficiencies were calculated as a function of dose, dose rate and flue gas composition. Comparison with experimental data shows that SO/sub 2/ and NO/sub x/ removals in the absence of NH/sub 3/ are predicted with reasonable accuracy by the computer model. In the presence of NH/sub 3/ experimental data show higher SO/sub 2/ removal efficiencies than calculated. This is probably due to additional heterogeneous reactions on particles, which are not covered by the computer model. With 119 figs., 86 refs..

5702 **(LUTKDH/TKKT—1001-1-158-1986) Experimental study on spray dry scrubbing.** Klingspor, J. (Lund Inst. of Tech. (Sweden). Dept. of Chemical Engineering). Apr 1986. 35p. Lund Inst. of Tech., Dept. of Chemical Engineering.

The rection kinetics of the spray dry scrubbing process for flue gas desulfurization (FGD) is discussed. Experimental studies were focused on the separate reaction periods in the spray drying concept. Both slaked lime and limestone were investigated. The dry reaction was studied in a small fixed bed reactor utilizing test conditions pertinent to baghouse operation. A detailed reaction mechanism of the dry reaction is presented. Also discussed is the use of additives to enchance the sorbent reactivity in order to make limestone applicable to the process. The spray dryer performance was studied in a 0.5 MW pilot plant. A detailed mathematical model on the spray dryer is presented. Also discussed are several ways of improving the limestone reactivity. Finely ground limestone is a feasible option when burning low sulfur coal. A laboratory size spray dry scrubbing process utilizing an ultrasonic nozzle for atomization was used to study the effect of grinding on recycle material reactivity. By grinding recycle material the unreacted nucleus in the particle can be exposed and the benefits from recycling be improved substantially.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 5771, 5913, 6397

5703 **(EPRI-EL—5230) Effect of space charge on surface insulation of high-voltage direct-current bushings: Final report.** Zaffanella, L.E. (General Electric Co., Lenox, MA (USA). High Voltage Transmission Research Center). Oct 1987. 39p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920072/JAW.

The objective of this study was to test the effectiveness of a method to improve the contamination flashover performance of bushings for HVDC (High Voltage Direct Current) applications. Such a method, consisting of installing intense corona producing elements at the high voltage electrode of a bushing, had given some encouraging results in a laboratory application. A series of laboratory tests was performed to verify and quantify this improvement. It was found that intense corona caused some effect in the initial development of partial discharges on the bushing surface. Improvement in flashover voltage appears significant only when the bushing surface is relatively clean and moisture deposition occurs predominantly by impingement of water particles suspended in air. Thus, the technique of using intense corona at the high voltage electrode may be advantageous in laboratory applications in which the bushing surface can be maintained clean. In practical outdoor applications, however, where significant degrees of contamination and wetting of surfaces either by condensation or by rain or mist may occur, the effect of corona is likely to be negligible. The results of flashover tests performed during this project add to the knowledge of the behavior of HVDC insulation in contaminated conditions. The poor performance of wall bushing has been ascribed to their large diameter.

5704 **(EPRI-EL—5383) Electrohydrodynamic pumping in distribution transformers: Final report.** Schwabe, R.J.; McMillen, C.J.; Sharbaugh, A.H. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Nov 1987. 62p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920081/JAW.

Tests of a 167-kVA distribution transformer equipped with an electrohydrodynamic pump explored the potential of this technology to improve transformer cost and/or performance. However, test data showed only marginal heat transfer benefits and a decline in pumping performance after 300 hours of operation. 3 refs., 39 figs.

5705 **(EPRI-EL—5414) Handbook for insulation coordination of high-voltage dc converter stations: Final report.** Flugum, R.W.; Reeve, J.; Hileman, A.R.; Breuer, G.D.; Elahi, H.; Brown, D.R.; Degenoff, R.C. (Main (Charles T.), Inc., Boston, MA (USA); General Electric Co., Schenectady, NY (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 314p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920067/JAW.

Insulation coordination of HVDC converter stations, while using the same basic principles as are used for ac substations, is complicated by several factors; large ac var sources, harmonic filters, several voltage levels, and series surge arresters among others. This handbook provides, along with considerable background data,

a step-by-step procedure for determining the appropriate surge arrester characteristics, and insulation withstand levels for both transmission and back-to-back dc systems. 29 refs., 86 figs., 54 tabs.

5706 **(EPRI-EL—5442) Distribution transformers not subject to destructive failure: Phase 3, Design improvements and preliminary market analyses: Final report.** Baranowski, J.F.; Goedde, G.L. (McGraw-Edison Power Systems Div., Franksville, WI (USA). Thomas A. Edison Technical Center; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 15p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920069/JAW.

This research project investigated the substitution of inorganic high temperature insulating materials for the oil/paper system in present transformer designs. A variety of designs for a transformer were studied and the processing techniques necessary to fabricate transformers were developed. Materials were found that could function successfully as turn-to-turn insulations and barrier insulations. But in order to utilize these materials effectively a pancake coil design had to be developed along with the necessary fabrication techniques. Twenty 25 kVA field test transformers were constructed and supplied to host utilities across the country. This report describes work to improve the transformer efficiency and to examine the feasibility of commercializing the non-destructive transformer technology. The initial market penetration would be limited to special utility and industrial market applications in competition with cast coil and open ventilated, dry-type transformers. This would involve larger kVA sizes and as a result, larger wide foil concentric designs were considered. It was expected that by building volume in this specialty market the cost of the inorganic materials would be reduced so that eventually this technology could compete in the distribution transformer market.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 5502, 5547, 5771, 5820

5707 (ANL/EES-TM—291, pp 37-48) **Characterization of radiological emergencies.** Chester, C.V. (Oak Ridge National Lab., TN). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

This paper identifies conditions that should be considered by the designers of mobile teleoperator equipment intended for service in radiological emergencies. We include a definition of radiological emergency and a taxonomy of emergencies. We will indicate the range of operating conditions that an equipment designer should consider and the type of operations that his machine might be expected to perform. 2 refs., 1 tab.

5708 **(FEI—1807) To the problems of diagnostics and evaluation of residual service life.** Bogomolov, V.N.; Mogil'ner, A.I.; Puchkova, L.V.; Shvetsov, D.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700597/JAW.

General problems related to technical diagnostics of an object and prediction of its technical state on the basis of reference mathematical models are considered. For the purpose it is expedient to conduct analysis of residue behaviour, i.e. differences between measured yield parameters and those estimated by the model. The approach suggested is illustrated by the example of steam generator state diagnostics. 2 refs.; 2 figs.

5709 **(KTA-GS—12(1987)) Nuclear Engineering Committee KTA. A collection of definitions as of January 16, 1987.** Riedel, U. (comp.). (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). 1987. 159p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750538/JAW.

The collection of definitions mainly comprises terms which are laid down in the recommendations of the Nuclear Engineering Committee (KTA) or in overriding regulations and specifications. The collection aims at a KTA-standardized use of terms and at the avoidance of groundless divergences. The compiled definitions are followed by a list of the sources considered, namely laws, ordinances, administrative recommendations, KTA regulations as well as other recommendations and standards. (orig./HSCH).

5710 **(UCRL—53804) Present and future nuclear power generation as a reflection of individual countries' resources and objectives.** Borg, I.Y. (Lawrence Livermore National Lab., CA (USA)). 26 Jun 1987. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001455/JAW.

The nuclear reactor industry has been in a state of decline for more than a decade in most of the world. The reasons are numerous and often unique to the energy situation of individual countries. Two commonly cited issues influence decisions relating to construction of reactors: costs and the need, or lack thereof, for additional generating capacity. Public concern has "politicized" the nuclear industry in many non-communist countries, causing a profound effect on the economics of the option. The nuclear installations and future plans are reviewed on a country-by-country basis for 36 countries in the light of the resources and objectives of each. Because oil and gas for power production throughout the world are being phased out as much as possible, coal-fired generation currently tends to be the chosen alternative to nuclear power production. Exceptions occur in many of the less developed countries that collectively have a very limited operating experience with nuclear reactors. The Chernobyl accident in the USSR alarmed the public; however, national strategies and plans to build reactors have not changed markedly in the interim. Assuming that the next decade of nuclear power generation is uneventful, additional electrical demand would cause the nuclear power industry to experience a rejuvenation in Europe as well as in the US. 80 refs., 3 figs., 22 tabs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 5780, 5797, 5804, 5817, 5819

5711 (ANL/EES-TM—291, pp 21-36) **Use of accident experience in developing criteria for teleoperator equipment.** Vallario, E.J.; Selby, J.M. (US Dept. of Energy, Washington, DC; Pacific Northwest Lab., Richland, WA). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

The 1961 SL-1 reactor accident in Idaho and the Recuplex accident at Hanford are reviewed to identify problems common to emergency situations, lessons learned from accidents, criteria for emergency equipment, and recommendations for using robotics to solve problems during emergencies. Teleoperator equipment could be used to assess the extent of the damage and the condition of the reactor, retrieve dosimeters, evacuate and treat accident victims, clean up debris and decontaminate accident areas. 2 refs., 8 figs.

5712 **(EPRI-NP—5438) Materials failure trends in LWRs: Final report.** Rajan, S.; Pyo, J.; Olson, E.; Strasser, A. (Stoller (S.M.) Corp., New York (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 75p. Research Reports Center, Palo Alto, CA 94303. Order Number DE88920058/JAW.

Materials failure trends in LWRs were identified by search of the data bases Nuclear Power Experience (NPE) and the Operating Plant Experience Code (OPEC) developed and maintained by the S.M. Stoller Corporation. Emphasis was placed on components that have not been extensively evaluated previously by EPRI. A generally decreasing materials failure rate was noted for most components in the time period of 1982 through 1984. Recommendations were made for improving the data base available to the industry, and for improving materials performance of high frequency failure components. 6 figs., 17 tabs.

5713 **(EPRI-NP—5521-SR) Failed fuel action plan guidelines: Special report.** (Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1987. 65p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920073/JAW.

The objective of this document is to provide a generic guideline that can be used to formulate a failed fuel action plan (FFAP) for specific application by a utility. This document is intended to be part of a comprehensive fuel reliability monitoring, management, and improvement program. The utilities may utilize this document as one resource in developing a failed fuel action plan. This document is not intended to be used as a failed fuel action plan standard. This document is intended to provide guidance on: management responsibilities; fuel performance parameters; cost/benefit analysis; action levels; long-term improvement methods; and data collection, analysis, and trending. 3 refs., 4 figs., 6 tabs.

5714 **(NUREG/CR—4990) Heavy-Section Steel Technology program: Five-year plan, FY 1986-1990.** (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Sep 1987. Contract AC05-84OR21400. 190p. (ORNL/TM—10526). NTIS, PC A09/MF A01 - GPO. Order Number TI88001595/JAW.

This is the fourth in the current annual series of five-year program plan documents presented for the Heavy-Section Steel Technology program. The program is carried out by the Oak Ridge National Laboratory for the Materials Engineering Branch, Division of Engineering, Office of Nuclear Regulatory Research of the US Nuclear Regulatory Commission. The program is primarily aimed at advancing the understanding and validation of the behavior of materials and structures behavior as they relate to the integrity of light-water reactor pressure vessels. The program has eleven technical tasks and a management function. A background statement and a plan-of-action are given in the following chapters for each task. Lists of reports publishd since the beginning of the program are included in appendices as part of the background information. The eleven technical tasks address fracture methodology and analysis, material properties and characterization, environmentally-assisted crack growth, crack arrest, irradiation effects, cladding evaluations, intermediate-vessel testing, thermal-shock testing, pressurized thermal-shock experiments, pressure-vessel-research users' facility, and shipping cask material evaluations. The last two of these tasks were initiated in FY 1987.

5715 **(NUREG/CR—5036) Cost analysis for implementation of proposed changes in vital area requirements.** Claiborne, E.; Watlington, B.; Simion, G.; Sciacca, F.; Riordan, B.; Godfrey, P.; Cohen, S. (Science and Engineering Associates, Inc., Albuquerque, NM (USA); Mathtech, Inc., Falls Church, VA (USA); SC and A, Inc., McLean, VA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Oct 1987. 120p. (SEA—87-253-05-A-1). NTIS, PC A06/MF A01 - GPO. Order Number TI88900146/JAW.

The Vital Area Committee (VAC) recently recommended changes to vital area requirements of nuclear power plants. Vital areas are those areas which contain vital equipment, and therefore, must be protected against radiological sabotage. In general, these recommendations are more relaxed than the current criteria contained in Review Guide 17 (RG-17). Before the VAC recommendations can be implemented, the NRC must perform a regulatory analysis. This study is a cost analysis of the RG-17 criteria and VAC recommendations to serve as one input to the regulatory analysis. The approach was to apportion the nuclear power industry into groups of similar plants, perform the cost analysis on selected plants from the groups, and extrapolate the results to the entire industry.

5716 **(EPRI-NP—4574-CCM-Pt.2-Ch.2) ARMP-02 documentation: Part 2, Chapter 2: Description of the CELL-2 fast and thermal cross-section libraries: Computer code manual.** Ozer, O.; MacFarlane, R.E.; Williams, M.L.; Cobb, W.R.; Tivel, D.E. (Electric Power Research Inst., Palo Alto, CA (USA); Los Alamos National Lab., NM (USA); Louisiana State Univ., Baton Rouge (USA); Nuclear Associates International Corp., Rockville, MD (USA)). Oct 1987. Contract W-7405-ENG-36. 68p. NTIS, PC A05/MF A01 - Research Repts. Ctr., Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88002136/JAW.

This chapter describes the multigroup fast (GAM) and thermal (THERMOS) cross section libraries generated for use with the ARMP-02 codes CELL-2 and EPRI-PRESS. Two sets of libraries are described. The first set referred to as "Production libraries" is basically the same as the GAM/THERMOS libraries distributed as part of the original ARMP release for use with the EPRI-CELL code, thus the appropriate documentation from the ARMP computer code manual (EPRI-CCM 3) is reproduced here. The second set of libraries is derived from the national standard data file: ENDF/B-V. The differences between this data and earlier versions of ENDF/B are summarized. This chapter also provides information on the energy group structures used by both sets of libraries, the prompt fission neutron spectra for uranium-235 and plutonium-239, the delayed neutron fractions (yields and decay constants) and the composition of mixed materials. 10 refs., 8 tabs.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 5712, 5713, 5714, 5715, 5716, 5784, 5787, 5794, 5795, 5799, 5800, 5801, 5802, 5803, 5804, 5805, 5806, 5807, 5808, 5809, 5810, 5814, 5817, 5818, 5819, 5821, 5824, 6235

5717 **(CONF-8710111—3) Aging assessment of auxiliary feedwater pumps.** Greenstreet, W.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001739/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

ORNL is conducting aging assessments of auxiliary feedwater pumps to provide recommendations for monitoring and assessing the severity of time-dependent degradation as well as to recommend maintenance and replacement practices. Cornerstones of these activities are the identification of failure modes and causes and ranking of causes. Failure modes and causes of interest are those due to aging and service wear. Design details, functional requirements, and operating experience data were used to identify failure modes and causes and to rank the latter. Based on this input, potentially useful inspection, surveillance, and condition monitoring methods that are currently available for use or in the developmental stage were examined and recommendations made. The methods selected are listed and discussed in terms of use and information to be obtained. Relationships between inspection, surveillance, and monitoring and maintenance practices entered prominently into maintenance recommendations. These recommendations, therefore, embrace predictive as well as corrective and preventative maintenance practices. The recommendations are described, inspection details are discussed, and periodic inspection and maintenance interval guidelines are given. Surveillance testing at low-flow conditions is also discussed. It is shown that this type of testing can lead to accelerated aging.

5718 **(CONF-8710111—4) Performance of low upper-shelf material under pressurized-thermal-shock loading (PTSE-2).** Bryan, R.H.; Bass, B.R.; Bolt, S.E.; Bryson, J.W.; Corwin, W.R.; Nanstad, R.K.; Merkle, J.G.; Robinson, G.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002297/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The second pressurized-thermal-shock experiment (PTSE-2) of the Heavy-Section Steel Technology Program was conceived to

investigate fracture behavior of steel with low ductile-tearing resistance. PTSE-2 was designed primarily to reveal the interaction of ductile and brittle modes of fracture and secondarily to investigate the effects of warm prestressing. A test vessel was prepared by inserting a crack-like flaw of well-defined geometry on the outside surface of the vessel. The flaw was 1 m long by ~15 mm deep. The instrumented vessel was placed in a test facility in which it was initially heated to a uniform temperature and was then concurrently cooled on the outside and pressurized on the inside. These actions produced an evolution of temperature, toughness, and stress gradients relative to the prepared flaw that was appropriate to the planned objectives. The experiment was conducted in two separate transients, each one starting with the vessel nearly isothermal. The first transient induced a warm prestressed state, during which K/ sub I/ first exceeded K/sub Ic/. This was followed by repressurization until a cleavage fracture propagated and arrested. The final transient was designed to produce and investigate a cleavage crack propagation followed by unstable tearing. During this transient the fracture events occurred as had been planned. 7 refs., 13 figs., 2 tabs.

5719 **(DOE/ET/34212—52) Development of an advanced extended burnup fuel assembly design incorporating urania-gadolinia: Ninth progress report, April 1985-March 1986.** Newman, L.W.; Rodes, J.R.; Holman, P.L.; Hove, C.M.; Hobson, G.M.; Mayer, J.T.; Aadland, J.D.; Papazoglou, T.P.; Aadland, P.C. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Oct 1987. Contract AC02-78ET34212. 150p. (BAW—1681-9). NTIS (US Sales Only), PC A07/MF A01; 1; GPO Dep. Order Number DE88002661/JAW.

The Babcock & Wilcox Company, Duke Power Company, and The United States Department of Energy are participating in an extended burnup project to develop, irradiate, and examine an advanced fuel assembly design for pressurized water reactors. The advanced fuel assembly uses a UO_2-Gd_2O_3 burnable absorber fuel mixture along with other state-of-the-art fuel performance and design features that enhance uranium utilization such as annular pellets, annealed guide tubes, Zircaloy intermediate spacer grids, and a removable upper end fitting. This report, covering April 1985 through March 1986, combines the ninth progress report for the program entitled "Development of an Advanced Extended Burnup Fuel Assembly Design Incorporating Urania-Gadolinia," and the fifteenth progress report for the program entitled "Qualification of the B & W Mark B Fuel Assembly for High Burnup." Under the latter program, standard Mark B fuel assemblies were irradiated and examined after three, four, and five cycles of operation to provide fuel performance data at extended burnup.

5720 (EPRI-NP—5158, pp 2.1-2.12) **Overview of primary side stress corrosion cracking in SG tubes of Electricite de France.** Berge, P. (Electricite de France, Saint Denis). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5721 (EPRI-NP—5158, pp 3.1-3.16) **Examination of cold leg roll transition zones at Ringhals 2.** Norring, K.; Engstrom, J. (Studsvik Energiteknik AB, Nykoeping, Sweden; Swedish State Power Board). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Ringhals 2 is a PWR of Westinghouse design put into operation in 1974. The unit has three Westinghouse Series 51 steam generators with mill annealed Alloy 600 tubing. The unit was operated for a few months at low power with a phosphate secondary water chemistry. This was changed in September 1974 to all volatile treatment (AVT). In 1981, cracks on the primary side at roll transition zones on the hot leg side were detected. Examination of 15 tubes removed in 1983 revealed that a majority of the roll transition zones on the hot leg side have such cracks. This examination established the importance of carbide distribution and geometry of roll transitions on this type of cracking. In 1984, five tubes were removed from the cold leg side as part of a life expectancy study. Examination of these tubes revealed primary side cracks in the roll transition zone on three of the five tubes. The microstructural characterization of the tube materials established that in all five tubes the carbide distribution was intragranular. The insides of the tube walls have been examined well away from the expanded part of the tubes. Intergranular attack was found on the hot leg. This attack is about one grain diameter deep and on the cold leg side the attack is very shallow. Nevertheless, the observations show a very slow intergranular attack on the primary side of the tubes.

5722 (EPRI-NP—5158, pp 4.1-4.11) **Update of operating plant experience with primary water stress corrosion cracking of steam generator tubing.** Gold, R.E. (Westinghouse Electric Corp., Pittsburgh, PA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5723 (EPRI-NP—5158, pp 5.1-5.30) **Critical factors assessment for U-bend and transition cracking.** Gorman, J.A.; Hunt, E.S. (Dominion Engineering, Inc., McLean, VA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Primary side intergranular stress corrosion cracking (IGSCC) is a widespread and continuing problem in Westinghouse (W) type steam generators. Of the 47 plants operating at least 5 years, over half have experienced varying degrees of primary side IGSCC. This type of cracking has not occurred at Babcock & Wilcox plants and only in one isolated case at Combustion Engineering plants. It has affected W type steam generators made by all manufacturers from nonthermally treated Alloy 600 tube material. IGSCC is considered to be caused by three coincident factors: susceptible material, aggressive environment, and tensile stress. Material susceptibility seems to correlate to the concentration of grain boundary carbides, grain size, and material strength and hardness. Tubes with copious amounts of intergranular carbides are less susceptible to primary side ISGSCC than those with few intergranular carbides and large amounts of carbides within the grains. The main fabrication variable which controls carbide morphology is the final mill anneal. Higher mill anneal temperatures generally result in less susceptible material. Remedial measures where cracking has already occurred is to install plugs or sleeves. For tubes with susceptible materials but not yet cracked, the following remedial measures can be considered: local thermal stress relief of U-bends; local thermal stress relief of expansion transitions; heat treatment of the entire tube sheet; and rotopeening or shot peening of expansion transitions.

5724 (EPRI-NP—5158, pp 6.1-6.27) **Relationship between microstructural features and tube cracking as observed on tube samples of a Doel 2 steam generator.** Tas, H.; Hernalsteen, P.; Houben, R.; Driesen, L. (SCK Mol, Belgium; Tractionel Brussels, Belgium; Kerncentrale Doel, Belgium). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Doel 1 and 2 are twin units with Westinghouse designed steam generators (SG) which have been operated similarly using an all volatile water treatment. Both have mill annealed Alloy 600 SG tubes but Unit 1 has not had any SG problems, whereas both steam generators in Unit 2 are seriously affected by primary side stress corrosion cracking (PSSCC) in the roll transition region. Nine tubes from Unit 2 steam generator "A" hot legs were examined metallurgically and an attempt was made to characterize the microstructure and correlate it with primary and secondary side cracking susceptibility. This paper describes the results of this examination.

5725 (EPRI-NP—5158, pp 7.1-7.28) **Assessment of crack growth in Alloy 600 steam generator tubes.** Gerber, T.L.; Farahm, B. (Structural Integrity Associates, San Jose, CA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5726 (EPRI-NP—5158, pp 8.1-8.20) **Development of a model for predicting IGSCC of Alloy 600 tubes in PWR primary water.** Garud, Y.S. (S. Levy Inc., Campbell, CA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5727 (EPRI-NP—5158, pp 9.1-9.8) **Use of activation energy for SCC to predict life of Alloy 600 in primary water.** Stein, A. (Stone & Webster Engineering Corp., Boston, MA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5728 (EPRI-NP—5158, pp 10.1-10.20) **Update on SCC of Alloy 600 in high temperature water.** van Rooyen, D. (Brookhaven National Lab., Upton, NY). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5729 (EPRI-NP—5158, pp 11.1-11.10) **Laboratory SCC results using Doel and Ringhals tubing.** van Rooyen, D. (Brookhaven National Lab., Upton, NY). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5730 (EPRI-NP—5158, pp 12.1-12.17) **Laboratory investigation of Alloy 600 SCC in high temperature water.** Saint Paul, P. (Electricite de France, Saint Denis). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5731 (EPRI-NP—5158, pp 13.1-13.15) **Accelerated SCC of Alloy 600 in 400°C steam environments.** Economy, G.; Jacko, R.J.; Klein, A.W.; Pement, F.W. (Westinghouse Research and Development Center, Pittsburgh, PA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Since the observation of stress corrosion cracking (SCC) of Alloy 600 in high purity water at 300°C to 350°C, it has been established that dissolved hydrogen accelerates the process and tends to increase the uniformity of initiation times. Thermal acceleration in pressurized water to 360°C to 365°C has been extensively used by a number of investigators but is limited by the critical point of water (374°C). The present program extends these test observations to 399°C, using superheated steam with and without hydrogen additions. This paper describes the results of these observations.

5732 (EPRI-NP—5158, pp 14.1-14.13) **Results of reannealing studies of Trojan, Doel 2, Ringhals 2 and 3, Ginna, and Indian Point 3 steam generator tubing.** McIlree, A.R. (Electric Power Research Institute, Palo Alto, CA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Final processing temperatures of tubing heats in current use are estimated in a reannealing study. Final anneal is suspected to have been low and consequently to have compromised material resistance to SCC. The technique used involves heating pieces of tubing for 3 to 5 minutes over a 899 to 1010°C (1650 to 1850°F) temperature range. By observing changes in grain size and carbide density, final processing temperature was estimated. This paper describes the results of this reannealing process.

5733 (EPRI-NP—5158, pp 15.1-15.19) **Microstructure, microchemistry, and microdeformation of Alloy 600 tubing.** Bruemmer, S.M. (Battelle Pacific Northwest Lab., Richland, WA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Microstructural and microchemical characterizations were performed on two heats of Alloy 600 tubing that have been shown to be susceptible to IGSCC in primary water environments. U-bend and straight section regions of one of the heats (Tube R1-C7 removed from Trojan steam generator D) were examined and compared. Microchemical differences were identified by analytical electron microscopy (AEM) and Auger electron spectroscopy (AES). Chromium concentrations were lower and phosphorus segregation higher in the U-bend region versus that in the straight section. While these differences were small, they appear to be statistically valid. Results suggest that microchemical changes can occur during service exposure and are accelerated by the presence of a heavily deformed microstructure.

5734 (EPRI-NP—5158, pp 16.1-16.16) **Effect of boron on the corrosion behavior of Alloy 600.** Nagano, H.; Yamanaka, K.; Kudo, T. (Sumitomo Metal Industries, Ltd., Amagasaki, Japan). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

The effects of boron on the intergranular corrosion and stress corrosion cracking (SCC) of nickel base Alloy 600, and the relationship between the segregation-precipitation behavior of boron and the corrosion resistance were investigated. The results obtained are as follows: Alloy 600 containing more than 7 ppM boron was highly susceptible to SCC in as annealed condition but not susceptible after aged at 700°C for 15 hours irrespective of boron content; boron accelerated the grain boundary precipitation of carbides when its content was more than about 11 ppM in as annealed condition; the time-temperature dependence of boron segregation and precipitation was characterized by C-curve at the temperature range between 400 and 1100°C; and the increase in the susceptibility of intergranular corrosion and SCC of Alloy 600 corresponded to the precipitation of fine continuous carbides at grain boundaries along which chromium depleted zones were formed.

5735 (EPRI-NP—5158, pp 17.1-17.19) **Low temperature SCC of high purity Ni-Cr-Fe alloys.** Was, G.S. (Univ. of Michigan, Ann Arbor). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5736 (EPRI-NP—5158, pp 18.1-18.30) **Influence of carbon content and mill annealing temperature on SCC in high temperature caustic.** Monter, J.V. (Babcock & Wilcox Co., Alliance, OH). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5737 (EPRI-NP—5158, pp 19.1-19.16) **Development of tubing microstructure as influenced by carbon content and mill-annealing temperature.** Ballinger, R.; Takemoto, M. (Massachusetts Institute of Technology, Cambridge). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5738 (EPRI-NP—5158, pp 20.1-20.16) **Role of processing on the development of Alloy 600 tubing microstructure.** Owens, C.M. (Combustion Engineering, Inc., Windsor, CT). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Plants have operated for as long as nine years with no experience of primary water stress corrosion cracking (PWSCC) of steam generator tubing. This experience represents the exposure of approximately 130,000 tubes to the primary water of nine separate plants. One of the factors presented to explain the favorable performance of C-E type steam generator tubing is the higher annealing temperature than that used for Westinghouse-type tubing. C-E tubing was produced to give average yield strengths around 41 ksi compared to 55 ksi or greater for Westinghouse-type tubing. The 41 ksi average yield strengths was achieved by using a 1875°F tube temperature. An exception to the favorable performance of C-E type tubing was a case of some tubing which went into service without receiving a proper annealing treatment. An adjacent section which had recrystallized during the furnace annealing treatment still had copious quantities of undissolved intragranular carbides. The undissolved carbide phase indicated that the actual tube temperature was below the maximum carbon solubility temperature. An ideal microstructure is developed when the tube temperature is high enough to dissolve the carbide phase. With a metal temperature of 1875°F, typical of C-E tubing, all material with carbon contents of 0.01 to 0.038 percent should receive an appropriate solution anneal.

5739 (EPRI-NP—5158, pp 21.1-21.10) **Development of microstructural correlations and a tubing specification for Alloy 600.** Stein, A.A. (Stone & Webster Engineering Corp., Boston, MA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

This paper presents a review of the existing microstructural data obtained from EPRI contractors and SGOG members. Microstructures are correlated with the material's resistance to SCC which, when combined with other data, provide a technical basis for an Alloy 600 steam generator tubing specification. The chemical and mechanical properties of Alloy 600 invoked in the specification are included and the SCC-crack-initiation time and temperature relationship is presented.

5740 (EPRI-NP—5158, pp 22.1-22.30) **Experimental measurements of leak rates and burst pressures for cracked Alloy 600 tubes under steam generator conditions.** Powell, D.E.; Hall, J.F. (Combustion Engineering, Inc., Windsor, CT). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

The objectives of this program are to measure leak rates in steam generator tubes under simulated typical operating and accident conditions and to measure burst pressures of defective tubes at operating temperatures. Concerns about the behavior of tubes with defects in operating steam generators prompted this study. Tubes in the field have developed intergranular stress corrosion cracks (both ID and OD initiated) in straight lengths, U-bend regions, and in tubesheet roll transition areas which have resulted in primary to secondary leakage and resulted in unscheduled outages. This report describes test conditions, material used, and test results.

5741 (EPRI-NP—5158, pp 23.1-23.9) **The residual stress study of Alloy 600 U-bend tubes using an advanced x-ray diffraction technique.** Ruud, C.O.; Ivkovich, D.P. (Pennsylvania State Univ., University Park). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

The stress state of Alloy 600 Row 1 U-bends has been determined. This has been accomplished first by measuring the residual stresses of as-fabricated U-bend tubes, measuring axial and hoop surface stress and the full field stress profile. Also the change in stress state resulting from pressurizing the U-bend tubes has been determined.

5742 (EPRI-NP—5158, pp 24.1-24.12) **Residual stress analysis of U-bends.** Gupta, G. (Foster Wheeler Development Corp., Livingston, NY). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Elastic-plastic analyses are being performed to determine residual stresses responsible for primary side IGSCC. A pseudo three-dimensional elastic stress analysis of the U-bend region of idealized and actual steam generator tubes was performed. The major recommendation of the analysis results was that while the elastic analysis characterized the operating stresses as intended, an evaluation of the residual stresses in the U-bend regions is necessary to determine an accurate correlation between tube cracking and state of tube stress.

5743 (EPRI-NP—5158, pp 25.1-25.14) **Evaluation of applied stresses.** Garud, Y.S. (S. Levy Inc., Campbell, CA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

One of the objectives of this project was to obtain better understanding of the state of stress as affected by various types of loadings and also by geometric parameters. This understanding is thought to be essential particularly from the standpoint of knowing which of these parameters are significant in the service of steam generator U-tubes and what's their significance in relation to the intergranular stress corrosion cracking (IGSCC). The first impressions of relevant tube stress analyses, without the use of finite elements method, were presented at this time.

5744 (EPRI-NP—5158, pp 26.1-26.26) **Mechanical and corrosion properties of Ni-Cr-Fe Alloy 600 related to primary side SCC.** Begley, J.A.; Jacko, R.J.; Gold, R.E. (Westinghouse Electric Co., Pittsburgh, PA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

The two-fold objective of the program is to provide the mechanical property data required for the development of a strain rate damage model for environmentally assisted cracking of Inconel 600 and to evaluate critical damage model parameters in primary water environments by conducting a series of stress corrosion tests. The test program includes mechanical property tests at 20°C, 316°C and strain rate tests to determine critical strain rate SCC parameters in primary water environments. Data are presented from slow strain rate tensile tests, stress relaxation tests and creep tests. A short discussion of the Gerber-Garud Strain Rate Damage Model is included to provide the background rationale for the test program. Utilitarian aspects of the Strain Rate Damage Model and the test program data are presented. Analysis of accelerated stress corrosion testing at high temperatures, and the contribution of thermally activated inelastic deformation to apparent activation energies for stress corrosion cracking is emphasized.

5745 (EPRI-NP—5158, pp 27.1-27.4) **Use of x-ray diffraction techniques for plastic deformation mapping.** Weissman, S. (Rutgers Univ., Piscataway, NJ). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

5746 (EPRI-NP—5158, pp 28.1-28.17) **Intergranular SCC of Alloy 600 in primary side PWR environments.** Szklarska-Smialowska, Z.; Cragnolino, G.; Totsuka, N. (The Ohio State Univ., Columbus). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Initial experiments on intergranular stress corrosion cracking of Alloy 600 in a solution of H_3BO_3 + LiOH, simulating primary water environments, are described. Slow strain rate tests (7.3 x 10^{-7}/s) were conducted to evaluate the role of hydrogen present in the environment or generated by the corrosion reaction. Tests were run in a specially designed high pressure recirculating loop at 300°C. Galvanostatic charging was used to promote the entry of hydrogen into the alloy.

5747 (EPRI-NP—5158, pp 29.1-29.12) **Corrosion potential measurements at Ringhals.** Rosborg, B.; Molander, A.; Svenson, J.; Andersson, P. (Studsvik Energiteknik AB, Nykoeping, Sweden; Swedish State Power Board). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Data from corrosion potential measurements in reactor water at Ringhals 4 are briefly reported. While the corrosion potentials of a number of materials are low and indistinguishable from each other at steady-state operation, and coincide with the electrode potential of a platinum electrode, they vary considerably and differently during a shut-down operation in the range -0.7 V SHE (as measured at 250°C) to 0.5 V SHE.

5748 (EPRI-NP—5158, pp 30.1-30.18) **PWR electrochemical potential measurements.** Kassen, W.R. (NWT Corp., San Jose, CA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

This presentation provides a status report on the preparations for the installation of an electrochemical potential test facility in the primary loop of the Trojan Nuclear Power Station. The project involved the design, fabrication, and installation of the test facility, and the qualification of reference electrodes to be used in the facility.

5749 (EPRI-NP—5158, pp 31.1-31.28) **In situ heat treatment U-bends.** Pement, F.W. (Westinghouse Electric Corp., Pittsburgh, PA). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

Initial efforts in the program are to evaluate the increased margin to primary water stress corrosion cracking (PWSCC) which results from a 788°C (1450°F), 15 minute heat treatment. This evaluation includes isothermal autoclave testing of reverse U-bend specimens, uniformly strained full-size tubing U-bends with a differential axial strain to simulate hot leg/cold leg differential expansion stresses. The testing program includes 3/4 in. OD and 7/8 in. OD tubing in both heat treated and non-treated conditions. The samples are tested at 680°F in high purity water with hydrogen overpressure, with a primary-to-secondary differential pressure of approximately 1500 psi. Initial results after 1300 hours of exposure indicate tangent point cracking on one of the three 7/8 in. diameter Row 1 U-bends of the most susceptible heat, tested in the as-fabricated condition. There is no apparent cracking in the three companion U-bends of this heat, tested in the 1450°F stress relieved condition.

5750 (EPRI-NP—5158, pp 32.1-32.12) **In-situ heat treatment of roll transition.** van Rooyen, D. (Brookhaven National Lab., Upton, NY). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

This work is intended to define heat treatments that would eliminate or give a large reduction in the incidence of primary side IGSCC in operating steam generator tubing. Earlier BNL data indicated that four stress relief heat treatments of roller expanded tubing were: 700°C for 4 mins., 750°C for 2 mins., 800°C for 1 min., and 850°C for 30 secs. Temperatures in excess of 750°C may, however, adversely affect the grain size of mill-annealed tubing. Vendors recommend as low a temperature as is practicable with respect to typical tube sheet material. No technological difficulties seem to exist to prevent an in-situ stress relief heat treatment from being feasible. Additional work was undertaken to find out if benefits could be obtained from heat treatments below 700°C, the main reason being to avoid possible adverse secondary effects.

5751 **(EPRI-NP—5428) Dimensional analysis of natural circulation experiments: Final report.** Zvirin, Y. (Technion-Israel Inst. of Tech., Haifa; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 47p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920061/JAW.

A method is presented to derive scaling rules for single- and two-phase natural circulation experiments simulating the behavior of nuclear reactor systems. These rules are obtained from the requirements of preserving the values of dimensionless groups in the normalized conservation equations. The main new results obtained here concern scaling of the secondary side fluid conditions and geometry, and of non-symmetric multiple loop operation. The method includes a complete derivation of the scaling rules, especially for the power, to account for heat transfer under conditions in laminar and turbulent flows, both in single-phase and a transition to two-phase flows. 10 refs.

5752 **(EPRI-NP—5462) Fracture mechanics evaluation of feedwater line failure at Surry-2: Final report.** Zahoor, A.; Gamble, R.M. (NOVETECH Corp., Rockville, MD (USA)). Oct 1987. 29p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920084/JAW.

The purpose of this work was to perform a fracture mechanics evaluation of a failure that occurred in an elbow of the 18-inch suction line to the "A" main feed pump at Surry Power Station, Unit 2. The failure occurred during a pressure transient subsequent to a reactor trip, which was initiated by a low-low steam generator level protection signal. Analyses were performed to characterize the crack formation and growth sequence at the estimated failure pressure (550 psi) and normal operating pressure (367 psi); this work included predicting the longitudinal throughwall crack lengths for initial wall breakthrough and failure. A sensitivity study also was performed to assess the effect on the results of variations in several conditions that generally influence failure.

5753 **(EPRI-NP—5496) In situ heat treatment of U-bends: Final report.** Pement, F.W.; Economy, G.; Aspden, R.G. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Nov 1987. 100p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920076/JAW.

Row 1 nuclear steam generator tubes of mill annealed Alloy 600 tubing were stress relief annealed at 1450°F for 15 minutes using a special internally placed flexible electrical resistance heater. The U-bends were strained to simulate differential thermal expansion stresses and tested for primary water stress corrosion cracking (PWSCC) resistance in two reference accelerated test environments (680°F high purity water and 750°F superheated steam), both of which contained hydrogen partial pressures. Prototypical axial throughwall cracking at the extrados of the irregular U-bend transition tangent was produced in base line, non-stress relieved U-bends, while no throughwall cracking occurred in any stress relieved sample. An improvement in PWSCC resistance due to this stress

relief of at least a factor of 30 can be inferred for the 7/8 in. tubing material that was of a highly PWSCC susceptible heat. The 3/4 in. tubing material, which was more resistant to PWSCC in the mill annealed condition, exhibited an inferred factor in PWSCC resistance, due to the 1450°F stress relief, or at least 11. The program identified and qualified a lower temperature, shorter time, stress relief cycle of 1300°F for five minutes. Accelerated PWSCC testing in 750°F steam indicated that 7/8 in. OD U-bends stress relieved at 1300°F for five minutes exhibit a resistance to PWSCC that is at least 100 times greater than as-bent samples that were readily cracked in the steam exposures. It is concluded that in-situ stress relief of mill annealed Alloy 600 nuclear steam generator U-bends is highly beneficial in reducing, or possibly eliminating, PWSCC at the U-bend tangent points where instances of PWSCC have been documented in operating plants. 10 refs., 44 figs., 16 tabs.

5754 **(HEDL-SA—3313-Rev.) Microstructural characteristics of PWR [pressurized water reactor] spent fuel relative to its leaching behavior.** Wilson, C.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1986. Contract AC06-76FF02170. 34p. (CONF-850536—11-Rev.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001465/JAW.

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

Microstructural, compositional and thermochemical properties of spent nuclear fuel are discussed relative to its potential performance as a high-level waste form under proposed Nevada Nuclear Waste Storage Investigations Project tuff repository conditions. Pressurized water reactor spent fuel specimens with various artificially induced cladding defects were leach tested in deionized water and in a reference tuff groundwater under ambient hot cell air and temperature conditions. Greater fractional actinide release was observed with bare fuel than with clad fuel leached through a cladding defect. Congruent actinide release and preferential release of cesium and technetium were observed in both water types. Selected summary radionuclide release data are presented and correlated to pre- and post-test microstructural characterization data.

5755 **(ITEF—148(1986)) Specific energy of /sup 235/U-/sup 238/U fuel cycles.** Zaritskaya, T.S.; Rudik, A.P.; Tsenter, Eh.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700686/JAW.

Mathematical statement and methods to solve the problem of reactor criticality maintenance in the /sup 235/U-/sup 238/U fuel cycle are described. Analysis of different modes of WWER-440 reactor criticality maintenance including the standard mode of WWER-440 operation, where /sup 235/U enrichment is 3.6%; the mode of useful absorber (i.e. /sup 238/U) makeup; the mode of makeup by nuclear fuel, i.e. by uranium of different enrichment; the mode of makeup by nuclear fuel with constant rate, is carried out. Nuclide composition and the character of makeup for different modes of criticality maintenance is presented. Analysis has shown that at high enrichment of primary loading reactor makeup by nuclear fuel (/sup 235/U) in the process of operation is most useful from the viewpoint of the specific energy, and at low enrichment - by useful absorber (/sup 238/U). 10 refs.; 8 tabs.

5756 **(KFKI—1987-44/G) Simulation of the dynamic behaviour of the secondary circuit of a WWER-440 type nuclear power plant Pt. 1.** Gacs, A.; Janosy, J.S.; Kiss, Zs. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1987. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700736/JAW.

This report describes the simulation model of the secondary circuit of a WWER-440 type nuclear power plant. The goal of this modelling is to simulate normal and small abnormal transients in a Basic Principles Simulator. The earlier reports describing the dynamic simulation of primary circuit of a WWER-440 nuclear power plant are KFKI--1983-127 and KFKI--1985-08. At present the controllers of the secondary circuit are not simulated. Finally, some simulation results are presented. 32 refs.; 17 figs.

5757 **(NUREG—1287) Technical specifications, Palo Verde Nuclear Generating Station, Unit No. 3 (Docket No. STN 50-530): Appendix "A" to License No. NPF-74.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Projects III, IV, V and Special Projects). Nov 1987. 487p. NTIS, PC A21/MF A01 - GPO. Order Number TI88900165/JAW.

This report presents specifications for the Palo Verde Nuclear Generating Station, Unit No. 3 concerning: safety limits and limiting safety system settings; limiting conditions for operation and surveillance requirements; design features; and administrative controls. (FI)

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 6207, 6435

5758 **(DOE/SF/02034—T90) Architect-Engineering and Consulting Services supporting the HTGR [high-temperature gas reactor] program: Final contract report, [October 1980 through October 1987].** (Bechtel National, Inc., San Francisco, CA (USA)). Nov 1987. Contract AC03-78SF02034. 29p. (GCRA/BEC—81-202). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002409/JAW.

Bechtel started work on the US DOE HTGR Program on October 15, 1980, under subcontract to Gas-Cooled Reactor Associates (GCRA). This work has continued without substantial interruption through 1987 and is scheduled to be completed in December 1987. This report covers the contract period from October 15, 1980 through October 1987. This report summarizes the work performed during this period and provides a tabulation by fiscal year listing major activities, accomplishments and deliverables. Bechtel was subcontracted to provide Architect-Engineer and related services in support of the High Temperature Gas-Cooled Reactor (HTGR) Program. Bechtel's initial work scope in October 1980 was to evaluate candidate process heat applications for compatibility with the HTGR heat source.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 5472, 5825, 5826, 5827, 5828, 5829, 5830, 5833, 5834, 5835, 5836, 5837, 5838, 6815

5759 **(FEI—1817) Thermophysical justification of temperature conditions for fast reactor fuel assemblies accounting for hot spot factors. Techniques and codes for thermohydraulic calculation of fast reactor fuel assemblies.** Zhukov, A.V.; Sorokin, A.P.; Ushakov, P.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 51p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700599/JAW.

The general scheme of hydrothermal fuel assembly calculation for fast liquid-metal cooled reactors is presented and analyzed. Techniques for calculation of local characteristics of velocity and temperature fields in fuel assemblies are described. They are based on finite element and variational methods for solution of motion and heat transfer equations in channels of complex configuration. The bases of by-channel method of hydrothermal fuel assembly calculation, allowing for the change of fuel assembly configuration during the reactor run and random parameter deviations from nominal values are presented. Some results of technique approbation on experimental data and results of calculation of velocity and temperature fields in fast reactor fuel assemblies are given. 27 refs.; 33 figs.

5760 **(KFK—4272) SATURN-S - a program system for the description of the thermomechanical behaviour of reactor fuel pins under irradiation.** Pesl, R.; Freund, D.; Gaertner, H.; Steiner, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jul 1987. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750555/JAW.

On the basis of post irradiation examination results of various irradiation experiments with different fuel types real case calculations showed many of the existing models to be applicable to a restricted extent only. Therefore a re- and partially new formulation of models was necessary. Furthermore, the data base had been actualized and numerical procedures had been improved. This, together with the capabilities of modern computer systems, conducted the development of the program system SATURN-S with a strictly modular structure, specified by the requirements of the determination of the superposition of effects. In the present report the program SATURN-S as well as some analysis results are presented.

5761 **(WAPD-TM—1609) Light Water Breeder Reactor rod removal system (LWBR Development Program).** Fodor, G.; Kikta, T.J.; Matchett, R.L.; Roof, D.R.; Wilczynski, R. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002087/JAW.

This report describes the design and operation of the robotic equipment for remote withdrawal of fuel rods from the Light Water Breeder Reactor (LWBR) fuel modules for proof-of-breeding assay and physical examinations. The Rod Removal System (RRS) was automated to minimize operator errors in removing specified rods while maintaining maximum control over forces applied during removal to preclude damage. The system determined the exact orientation of the fuel module and the positions of fuel rods within the module. The module being derodded was oriented vertically in a support stand in a 35-foot water pit at the Expended Core Facility at the Idaho National Engineering Laboratory. The tops of preselected rods were engaged by a programmed mechanical grapple, which was capable of collecting rod pull force data while 10-foot long rods were withdrawn vertically from modules. Pulled rods were transferred to preselected ports in a multiport storage container or inserted into shrouds prepositioned in a rod transfer container. The RRS removed approximately 1100 fuel rods from 12 of the 39 LWBR fuel modules without a major equipment or operational problem. 3 refs., 19 figs.

5762 **Fission product detection system in support of fast reactor safety experiments.** Braid, T.H.; Boyar, R.E.; Devolpi, A.; Doerner, R.C.; Fink, C.L.; Rhodes, E.A. (Argonne National Lab., IL, USA). pp 287-288 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

A collimated detection system has been used to observe fission products in the upper regions of a test loop in the Treat reactor. Particular regions of the loop are targeted through any of five channels in a rotatable assembly in a horizontal hole through the biological shield. A well-type neutron detector, optimized for delayed neutrons, and two GeLi gamma ray spectrometers have been used in several experiments. Data are presented showing a time history of the transport of dn emitters, of gamma spectra identifying volatile fission products deposited as aerosols, and of fission gas isotopes released from the coolant.

5763 **Fuel-motion diagnostics in support of fast-reactor safety experiments.** Devolpi, A.; Doerner, R.C.; Fink, C.L.; Regis, J.P.; Rhodes, E.A.; Stanford, G.S. (Argonne National Lab., IL, USA). pp 289-294 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

In all destructive fast-reactor safety experiments at Treat, fuel motion and cladding failure have been monitored by the fast-neutron/gamma-ray hodoscope, providing experimental results that are directly applicable to design, modelling, and validation in fast-reactor safety. Hodoscope contributions to the safety program can be considered to fall into several groupings: pre-failure fuel motion, cladding failure, post-failure fuel motion, steel blockages, pretest and post-test radiography, axial-power-people variations, and power-coupling monitoring. High-quality results in fuel motion have been achieved, and motion sequences have been reconstructed in qualitative and quantitative visual forms.

5764 **FPIN2 code - an application of the finite element method to the analysis of the transient response of oxide and metal fuel elements.** Hughes, T.H.; Kramer, J.M. (Argonne National Lab., IL, USA). pp 427-432 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

The FPIN2 code simulates the thermal-mechanical response of fast reactor fuel pins to transient events. Temperatures of the fuel pin and coolant are calculated using a simple pin-in-a-pipe geometry. The mechanical analysis uses an implicit finite element formulation with linear shape functions which allow for general material behavior in the fuel and cladding including cracking and melting. This formulation provides a very convenient structure for implementing different models and improvements in algorithms. The paper summarizes the FPIN2 methodology and presents results for the transient response of both oxide and metallic fuel pins under similar overpower transients.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

5765 **(N—87-27495) Assessment and validation study of nuclear reactors for low power space applications. Final report 1986, 1 November-30 April 1987.** Klein, A.C.; Gedeon, S.R.; Morey, D.C. (Oregon State Univ., Corvallis (USA)). Jun 1987. 53p. (NASA-CR—180672; NAS—1.26:180672; OSU-NE—8702). NTIS, PC A04/MF A01.

The feasibility and safety of six conceptual small, low power nuclear reactor designs was evaluated. Feasibility evaluations included the determination of sufficient reactivity margins for seven years of full power operation and safe shutdown as well as handling during pre-launch assembly phases. Safety evaluations were concerned with the potential for maintaining subcritical conditions in the event of launch or transportation accidents. These included water immersion accident scenarios both with and without water flooding the core. Results show that most of the concepts can potentially meet the feasibility and safety requirements; however, due to the preliminary nature of the designs considered, more detailed designs will be necessary to enable these concepts to fully meet the safety requirements.

5766 **(SAND—87-2067) Specific power of liquid-metal-cooled reactors.** Dobranich, D. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002815/JAW.

Calculations of the core specific power for conceptual space-based liquid-metal-cooled reactors, based on heat transfer considerations, are presented for three different fuel types: (1) pin-type fuel; (2) cermet fuel; and (3) thermionic fuel. The calculations are based on simple models and are intended to provide preliminary comparative results. The specific power is of interest because it is a measure of the core mass required to produce a given amount of power. Potential problems concerning zero-g critical heat flux and loss-of-coolant accidents are also discussed because these concerns may

limit the core specific power. Insufficient experimental data exists to accurately determine the critical heat flux of liquid-metal-cooled reactors in space; however, preliminary calculations indicate that it may be a concern. Results also indicate that the specific power of the pin-type fuels can be increased significantly if the gap between the fuel and the clad is eliminated. Cermet reactors offer the highest specific power because of the excellent thermal conductivity of the core matrix material. However, it may not be possible to take fuel advantage of this characteristic when loss-of-coolant accidents are considered in the final core design. The specific power of the thermionic fuels is dependent mainly on the emitter temperature. The small diameter thermionic fuels have specific powers comparable to those of pin-type fuels. 11 refs., 12 figs, 2 tabs.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 5715, 5757, 5758

5767 **(NUREG—0040-Vol.11-No.3) Licensee contractor and vendor inspection status report: Quarterly report, July 1987-September 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards). Oct 1987. 163p. NTIS, PC A08 - GPO. Order Number TI88900152/JAW.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from July 1987 through September 1987. Also included in this issue are the results of certain inspections performed prior to July 1987 that were not included in previous issues of NUREG-0040.

5768 **(NUREG—0304-Vol.12-No.3) Regulatory and technical reports (Abstract Index Journal): Compilation for third quarter, July-September 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Nov 1987. 54p. NTIS, PC A04/MF A01 - GPO. Order Number TI88900164/JAW.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

5769 **(NUREG/CR—2000-Vol.6-No.9) Licensee event report (LER) compilation for month of September 1987.** (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 77p. (ORNL/NSIC—200-Vol.6-No.9). NTIS, PC A05/MF A01 - GPO. Order Number TI88002526/JAW.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983.

2108 Economics

REFER ALSO TO CITATION(S) 5559, 5784

5770 **(MLM—3463(OP)) Decontamination and decommissioning of Building 41.** Rader, P.L.; Creech, P.W.; Michigan, R.J. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 5p. (CONF-871018—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002318/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Building 41 was a one story, above-ground 36' x 9' x 9' concrete block structure with a fifteen foot poured concrete basement that contained two 3500 gallon tanks and pumping system. A pole barn structure was erected over Building 41 to contain contamination during removal. Steel sheet piling and oak shoring eliminated cave in dangers. Removal was accomplished with a remote excavator trackhoe and concrete bucket. Final excavation, sampling and surveying are in process. Upon final release, the excavation will be sealed, filled and the site restored.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 5709

5771 **(EDF-DER-RA—1986-1) DER 86 panorama.** (Electricite de France, 75 - Paris). 1987. 290p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750621/JAW.

This progress report presents the panorama of the studies carried out by the "Direction des Etudes et des Recherches" (E.D.R.): nuclear boilers; classical and nuclear thermal power plants, hydraulic power plants; electrical equipment; network analysis; environmental impacts; uses of electric power; new aspects of energy; applied informatics and mathematics; normalization and patents. A selection of the publications of 1986 is finally presented. 680 refs.

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 5785

2202 Components And Accessories

REFER ALSO TO CITATION(S) 6276

5772 **(IVA—311) Power plant emissions and their ecological effects. Swedish-Czechoslovak seminar.** (Royal Swedish Academy of Engineering Sciences, Stockholm). 1986. 196p. (CONF-8506372—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750397/JAW.

From Seminar on power plant emission and their ecological effects; Ceske Budejovice, Czechoslovakia (10 Jun 1985).

In cooperation with the Czechoslovak Academy of Sciences in Ceske Budejovice, the Royal Swedish Academy of Engeneering Science, IVA, and the Royal Swedish Academy of Agriculture and Forestry, KSLA, initiated a Czechoslovak - Swedish Workshop, / sup E/missions from Energetic Sources and Their Ecological Impact/sup ,/ which was held June 10 and 11, 1985. The workshop provided a good opportunity for exchanging information on this important issue and rendered open and fruitful discussions, resulting in a mutual agreement on future cooperation according to the Appendix to this report. This report contains the lectures as well as an account of the discussions held at the workshop. On behalf of the two Swedish Academies, we convey our deep gratitude to the Czechoslovak Academy for enabling this cooperation and for the program arranged for the Swedish delegation. A special note of thanks will go to RNDr. Jaromir Pospisil and his colleagues, Drs. Martin Sima and Hana Rambouskova, at the Institute of Landscape Ecology of the Czechoslovak Academy of Sciences in Ceske Bude-

jovice, as well as to the Czechoslovakian scientists attending the workshop and meeting with the Swedish delegation.

5773 **(NP—8900145) A preliminary design of an underwater debris vacuum system.** Krispin, F.F.; Burk, R.A.; Sharpe, J.R.; Sanders, R.L.; Boyd, R.L.; Bales, J.D. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 1 Jul 1985. 90p. NTIS, PC A05/MF A01. Order Number DE88900145/JAW.

A loss of cooling water accident (LOCA) occurred at an 880 MWe nuclear power plant which resulted in substantial damage to the core of the reactor. At the high temperatures reached during the accident, some of the cladding became brittle and fractured into small pieces. These pieces of cladding along with fuel pellets are thought to have been deposited on the bottom of the core as well as in the lower head vessel region of the reactor. The purpose of this report is to present a preliminary design of an underwater vacuum system that will vaccum and filter the debris from the core and lower head vessel regions.

5774 **(SKI—84092-Pt.1) Evaluation of free jet and jet impingement tests with hot water and steam. Final report covering phase 1 and 2 of the JITEV project. Part 1: Text and Tables.** Marklund, J.E. (Swedish Nuclear Power Inspectorate, Stockholm; Studsvik Energiteknik AB, Nykoeping (Sweden)). 21 May 1985. 178p. (STUDSVIK-NR—85-54-Pt.1). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750365/JAW.

Large scale free jet and jet impingement tests with hot water and steam were performed at the Marviken test facility, Sweden in the JIT project 1980-1981. Similar tests, but with smaller scale equipment, were performed in Canada, Italy and Japan. Results from these tests were made available to the JIT project as in-kind contributions. The present report summarizes an evaluation effort over these large and small scale tests, as well as some additional small scale tests. A preliminary assessment of some computer code models and other theoretical models or correlations is also included. The work was financially supported by the Swedish Nuclear Power Inspectorate, and in phase 1 also by the Electric Power Research Institute (EPRI), USA. Part 1 of the report contains text and tables, while the figures are contained in a separate cover, Part 2. With 93 refs.

5775 **(SKI—84092-Pt.2) Evaluation of free jet and jet impingement tests with hot water and steam. Final report covering phase 1 and 2 of the JITEV project. Part 2: Figures.** Marklund, J.E. (Swedish Nuclear Power Inspectorate, Stockholm; Studsvik Energiteknik AB, Nykoeping (Sweden)). 21 May 1985. 186p. (STUDSVIK-NR—85-54-Pt.2). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750366/JAW.

Large scale free jet and jet impingement tests with hot water and steam were performed at the Marviken test facility, Sweden in the JIT project 1980-1981. Similar tests, but with smaller scale equipment, were performed in Canada, Italy and Japan. Results from these tests were made available to the JIT project as in-kind contributions. The present report summarizes an evaluation effort over these large and small scale tests, as well as some additional small scale tests. A preliminary assessment of some computer code models and other theoretical models or correlations is also included. The work was financially supported by the Swedish Nuclear Power Inspectorate, and in phase 1 also by the Electric Power Research Institute (EPRI), USA. Part 1 of the report contains text and tables, while the figures are contained in a separate cover, Part 2.

5776 **(SKI-B—69-82) Final report on the Swedish participation in PISC II.** Hoegberg, K.; Zettewall, T. (Swedish Nuclear Power Inspectorate, Stockholm; Swedish Plant Inspectorate, Stockholm). Aug 1986. 82p. (In Swedish). (SAFOU—86-05). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750359/JAW.

The aim of the project is to evaluate the reliability of test methods for reactor pressure vessels and to identify the proper methods for defect control and to inform about the results. Four test plates planted defect have been investigated by 50 testing teams from 13 countries. Swedish testing has shown acceptable data for the detection of defects when using high sensitivity tests. (G.B.).

5777 **(SKI-B—86071) Method for selecting recurrent controls of the tubes and components of the process systems.** Oehlin, L. (Swedish Nuclear Power Inspectorate, Stockholm; ASEA-ATOM AB, Vaesteraas (Sweden)). 22 Jan 1987. 270p. (In Swedish). (ASEA-ATOM-RVB—86-364). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750361/JAW.

The existing rules and recommendations for the inspection of the components of nuclear power plants are considered inadequate. Therefore some new directions have been worked out for suitable distribution of controlling actions. The new concept will cover the probability of fractures and the consequences of accidents. Control procedures will stress safety aspects in particular. (G.B).

2203 Fuel Elements

REFER ALSO TO CITATION(S) 6445

5778 **(NIIAR—11(692)) Set of process equipment for welding of irradiated fuel cans.** Zinkovskij, V.I.; Krylov, E.A.; Brovko, V.V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700741/JAW.

Process and engineering development related, to creation of a set of specialized equipment for welding of irradiated fuel cans is described. The set of in-cell process equipment includes: machine for mechanical processing of irradiated fuel cans, a unit for argon-arc welding by ring weld and by through flashing the face by a stationary arc, container for impregnation with helium, units for monitoring the leak-proofness by vacuum-liquid and mass-spectrometry methods. Irradiated fuel can welding flowsheet is presented Irradiated fuel can welding flowsheet is presented. 3 refs.; 4 figs.

2204 Control Systems

5779 **(CEA-N—2515) Digital module for neutron flux measurement by Campbell method.** Baratte, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Electronique et d'Instrumentation Nucleaire). Feb 1987. 132p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750620/JAW.

The study reported here concerns a wide range measurement channel for reactor control instrumentation but it may also be useful for specific measurements requiring the Campbell method. A wide range measurement channel allows the processing of the signal issued from a single fission chamber so it's possible to insure control of nuclear reactors in three different running modes: pulse processing, fluctuations and current. The study described in this note includes three parts: the analogical wide range neutron measurement channel is presented in the first chapter; the fluctuation mode is thoroughly studied; the results of tests and proper limitations of analogical processing are summarized. A theoretical study of the neutron flux measurement by numerical calculation of the fluctuation signal variance is given in the second chapter. The digital module is described in the third chapter; the results of experiments are analysed. The validity of the digital method is proved by means of a practical realisation. The performances obtained with the digital fluctuation test model may be compared with those given by the analogical fluctuation channel which can be used for the control of lower fission rates. The digital module may also be used for any fluctuation measurement where very short response time and broad spectral band of analysis are not strictly necessary.

5780 **(EPRI-NP—5502) Requirement and design specifications of a BWR [boiling-water reactor] digital feedwater control system: Final report.** (Science Applications International Corp., San Diego, CA (USA)). Nov 1987. 203p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920074/JAW.

The objective of this project was to develop and demonstrate a fault-tolerant, microprocessor-based digital feedwater control system (DFCS) for the Northern States Power (NSP) Monticello Nuclear Power Plant as a replacement for the existing analog

control system. Task A of this project consisted of a feasibility study and was documented as EPRI NP-3323. The objective of Task B was to implement the results of the feasibility study by proceeding with the detailed design and implementation phase of the project. A prototype digital feedwater controller has been designed based on a software implementation of proportional-integral-differential (PID) control which met the functional requirements developed in Task A. Detailed design specifications for both hardware and software were developed. A system reliability analysis was performed which showed that the design goal of 1.5 failures per million operating hours can be achieved using the fault-tolerant architecture. A validation and verification test plan was developed which ensured that the DFCS satisfies all functional requirements. 10 refs., 5 figs., 3 tabs.

5781 **(ERGONOMRAAD-R—26) Strategy for man-machine system development in process industries.** Wirstad, J. (Ergonomraad AB, Karlstad (Sweden)). Dec 1986. 84p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750369/JAW.

A framework for Man-Machine System design in process industry projects is reported. It is based in the Guidelines for the Design of Man-Machine interfaces which have been generated in cooperation within the European Workshop for Industrial Computer Systems (EWICS). The application of EWICS Guidelines in industrial projects is demonstrated by six User Scenarios, which represent typical projects from different industries, e.g. electrical power generation and distribution, water control, pulp and paper production, oil and gas production. In all these projects Man-Machine System design has been conducted. It is recommended in the report that each Company develops its set of Man-Machine Systems Standard techniques/procedures. At present there are several techniques/procedures available which, for moderate costs, can be adapted to specific Company conditions. A menu of such Man-Machine System techniques/procedures is presented. Means of estimating the costs and benefits of Man-Machine System design are also described.

5782 **(LUTFG2-TFRT—3181-1-025-1986) New forms of man-machine interaction.** Mattsson, S.E.; Elmqvist, H.; Brueck, D. (Lund Univ. (Sweden). Dept. of Automatic Control). 29 Sep 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750370/JAW.

The new workstation with high performance graphics offer new possibilities for visualizing and giving a more concrete form to important concepts. In this project, some of these possibilities have been investigated by developing and implementing a prototype simulator for dynamical systems. The attention has been focused on the user interface for model development. In automatic control the notion of system is important and its representation is a key issue. The simulator support hierarchical block diagrams to describe the model decomposition and the interconnection structure. At the highest level the user sees a block diagram of annotated boxes connected with lines. The user can scroll, pan and zoom the block diagram continuously in real-time. Zooming controls the amount of information displayed. When zooming in on a block, it changes from an annotated box into a representation showing internal structure with increasing detail. Since the block diagrams can be hierarchical, it is possible to make the description at each level simple and clear. The simulator is called Hibliz which stands for HIerarchial BLock diagrams with Information Zooming. The user creates and edits his block diagrams in a Mackintosh-like fashion. He can also create overview windows which indicated where he is when he pans and zooms. Hibliz also simplified model development by allowing submodels in the form of ordinary differential and algebraic equations rather than assignment statements for derivatives and algebraic variables. (authors).

5783 **(RISO-M—2645) Representation of process state, structure and control.** Goodstein, L.P.; Rasmussen, J. (Risoe National Lab., Roskilde (Denmark)). Apr 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750349/JAW.

Supervisory control is essentially a decision-making activity where, among other things, the dm has to maneuver within a complex problem space which reflects key dimensions and attributes of the object system (power plant ...). Of considerable importance therefore is the representation for the dm of this problem space comprising at the one end the target demands, goals, constraints and, at the other, the resources available for meeting the assigned goals - and all of this in pace with the dynamic event-driven environment which characterizes the types of systems of interest. Previous work has identified the advantages of utilizing the two-dimensional means-ends/part-whole space as a basic ingredient in a system representation. This paper associates more detailed representational requirements at the various levels of the means-ends axis with the activities of state identification and diagnosis. In addition, some examples of display formats which attempt to incorporate the outlined representational principles within the context of a PWR plant are discussed. (authors). 13 refs.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 5707, 5711, 5797, 5798, 5799, 5800, 5802, 5804, 5805, 5880, 6207

5784 **(DOE/SSDP—0026) Scheduling for decommissioning projects.** Podmajersky, O.E. (General Electric Co., Shippingport, PA (USA). Nuclear Energy Business Operations). 1987. Contract AC06-76RL01857;AC06-84RL10421. 8p. (CONF-871018—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001860/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper describes the Project Scheduling system being employed by the Decommissioning Operations Contractor at the Shippingport Station Decommissioning Project (SSDP). Results from the planning system show that the project continues to achieve its cost and schedule goals. An integrated cost and schedule control system (C/SCS) which uses the concept of earned value for measurement of performance was instituted in accordance with DOE orders. The schedule and cost variances generated by the C/SCS system are used to confirm management's assessment of project status. This paper describes the types of schedules and tools used on the SSDP project to plan and monitor the work, and identifies factors that are unique to a decommissioning project that make scheduling critical to the achievement of the project's goals. 1 fig.

5785 **(EPRI-NP—5455) BWR [boiling-water reactor] radiation control: In-plant demonstration at Vermont Yankee: Final report.** Palino, G.F.; Hobart, R.L.; Sawochka, S.G. (NWT Corp., San Jose, CA (USA)). Oct 1987. 175p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920083/JAW.

Results of the RP1934 program, which was established by EPRI in 1981 to demonstrate the adequacy of BRAC program (RP819) principles for BWR radiation control at Vermont Yankee, are presented. Evaluations were performed of the effectiveness of optimization of purification system performance, control of feedwater dissolved oxygen concentrations, minimization of corrosion product and ionic transport, and improved startup, shutdown, and layup practices. The impact on shutdown radiation levels of these corrective actions was assessed based on extensive primary system radiation survey and component gamma scan data. Implementation of the BRAC recommendations was found to be insufficient to reduce the rate of activity buildup on out-of-core surfaces at Vermont Yankee, and additional corrective actions were found necessary. Specifically, replacement of cobalt-bearing materials in the control rod drive pins and rollers and feedwater regulating valves was pursued as was installation of electropolished 316 stainless steel during a recirculation piping replacement program. Aggressive programs to further reduce copper concentrations in the reactor water by improving condensate demineralizer efficiency and to minimize organic ingress to the power cycle by reducing organic concentrations in recycled radwaste also were undertaken. Evaluations of the impact on activity buildup of several pretreatment processes including prefilming in moist air, preexposure to high temperature water containing zinc, and electropolishing also were performed in a test loop installed in the reactor water cleanup system. A significant

beneficial impact of electropolishing was shown to be present for periods up to 6000 hours.

5786 **(NUREG—0837-Vol.7-No.2) NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, April-June 1987.** Jang, J.; McNamara, N.; Cohen, L. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Oct 1987. 225p. NTIS, PC A10 - GPO. Order Number TI88900096/JAW.

The US Nuclear Regulatory Commission (NRC) Direct Radiation Monitoring Network is operated by the NRC in cooperation with participating states to provide continuous measurement of the ambient radiation levels around licensed NRC facilities, primarily power reactors. Ambient radiation levels result from naturally occurring radionuclides present in the soil, cosmic radiation constantly bombarding the earth from outer space, and the contribution, if any, from the monitored facilities and other man-made sources. This report presents the radiation levels measured around all facilities in the Network for the first quarter of 1987. A complete listing of the site facilities monitored is included. All radiation measurements are made using small, passive thermoluminescent dosimeters (TLDs), which provide a quantitative measurement of the radiation levels in the area in which they are placed. Each site is monitored by arranging approximately 40 to 50 TLD stations in two concentric rings extending to about five miles from the facility. All TLD stations are outside the site boundary of the facility. The radiation levels are presented as gross and net exposures. The gross exposure includes naturally occurring background radiation, radiation levels resulting from a facility's operation, and the exposure received during transport and storage of the TLD. Net exposures are obtained by subtracting an estimate of the exposure received by the dosimeter during transit from the gross exposures. All exposures are normalized to a 90-day quarter (standard quarter) and reported in units of milliroentgens (mR).

5787 **(PB—87-227872/XAB) Environmental radionuclide concentrations in the vicinity of the Calvert Cliffs Nuclear Power Plant: 1981 - 1984. Data report.** Domotor, S.L.; McLean, R.I. (Maryland Power Plant Research Program, Annapolis (USA)). Jul 1987. 72p. (PPRP-R—8). NTIS, PC A04/MF A01.

High-resolution gamma spectroscopy was used to determine radionuclide concentrations in over 700 sediment, finfish, shellfish, and aquatic-vegetation samples collected from the Chesapeake Bay in the vicinity of the Calvert Cliffs Nuclear Power Plant (CCNPP) during 1981-1984. Naturally-occurring radionuclides (K-40; thorium and uranium decay products) and weapons-test-fallout radionuclides (principally Cs-137) were detected in all samples. The down-Bay transport of radionuclide-labelled particulates was documented in sediments collected from stations located 8 km south of CCNPP. Low concentrations of Sr-90 detected in biota collected at plant-site and Farfield locations were not significantly different and are attributable to weapons-test fallout. The low quantities of radioactivity discharged by CCNPP provide small increments to radionuclide concentrations in the Bay relative to natural and weapons-test levels.

5788 **(SNV—3060) Radionuclides in the environment around Swedish nuclear power stations, 1983.** Notter, M. (National Swedish Environmental Protection Board, Solna). Feb 1986. 54p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750368/JAW.

Annual samples of animals and plants from land and water environments are taken at the Swedish nuclear power stations. The samples are analyzed for gamma radiation and in some cases also alpha radiation. This monitoring is done to investigate whether the radioactive discharge from the nuclear power stations can be detected in the environment. The present report contains results from the investigations made in 1983. The influence of radioactive nuclides discharged from the nuclear power stations is found to be limited. Detectable quantities of radionuclides can only be demonstrated in the immediate vicinity of each power station. Important accumulators of radionuclides are mussels, bladder wrack, mosses and lichens. Fish are the most important link for radionuclides in the nutrient chain to man. There are difficulties in relating uptake in fish to the discharge data since fish are mobile which makes it impossible to calculate the total load of radionuclides to which the fish are exposed. Finally, it is observed that the radioactive discharge from the Swedish nuclear power stations contributes maximally 2 percent of the background radiation originating from cosmic radiation. This implies that the radiation dose to man resulting from the normal operation of nuclear power stations is of marginal importance.

5789 **(TVA/PUB—88/4) Three archeological sites near Hartsville: Smith and Trousdale Counties, Tennessee: Dixon Creek (40SM113), Oldham (40SM108), and Celsor (40TR20).** McNutt, C.H.; Lumb, L.C.; Stevenson, D.R. (Memphis State Univ., TN (USA). Anthropological Research Center). 1987. 203p. NTIS, PC A10/MF A01. Order Number DE88900174/JAW.

This is a study of material obtained during the mid-1970s from 3 sites, as part of a TVA archeological program on the site of the proposed Hartsville Nuclear Plant. (DLC)

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 5804, 5831, 6935, 6936

5790 **(FEI—1769) Buffer counter and timer modul for the Electronica-60 computer.** Zajtsev, M.Yu.; Regushevskij, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700594/JAW.

A block diagram of buffer counter and timer module, stabilized by a quartz resonator, is described. The module comprises KR 580 VI 53 integrated circuits and may be connected to the Electronika-60-type computer channel. 4 refs.; 3 figs.

5791 **(JINR—R-3-86-592) Measurement of heat release in hydrogeneous moderator.** Melikhov, V.V.; Shabalin, E.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700518/JAW.

Specific heat release has been experimentally found through the thick of hydrogenous moderator. Heat release due to elastic scattering of neutrons on hydrogen has been obtained by the results on measuring temperature in nonstationary conditions of moderator model heating with the IBR-2 reactor radiation. Maximum specific heat was 0.05 W/cm/sup 3/ per 1 MW of reactor power, which agrees well with the calculated data. Basing on nonstationary measurements of temperature of aluminium sample placed in the moderator model the estimation of γ-radiation energy deposition in structure materials was carried out. It has been found that it does not exceed 0.05 W/g per 1 MW of reactor power. 1 ref.; 6 figs.; 3 tabs.

5792 **New facility for averaged resonance capture studies at the Omega West reactor.** Stelts, M.L.; Bendt, P.J. (Los Alamos National Lab., NM, USA). *Nuclear Instruments and Methods in Physics Research;* **258**: No. 2, 195-200(1 Aug 1987). Contract W-7405-ENG-36.

A facility has been developed at the Omega West reactor at Los Alamos to provide neutron beams of 2 and 24 keV average neutron energies. The neutron beam currents are comparable with those obtained at the Brookhaven high flux beam reactor. A three-crystal pair spectrometer has been developed to allow acquisition of high resolution primary neutron capture gamma ray spectra. This will be used for nuclear spectroscopy and structure studies.

5793 **1986 reference neutron dosimetry for the Health Physics Research Reactor.** Sims, C.S. (Oak Ridge National Lab., TN, USA). *Radiation Protection Dosimetry;* **15**: No. 1, 41-44(1986).

The Health Physics Research Reactor (HPRR) has recently undergone modifications associated with its positioning mechanism. While the core and the control rods were unchanged, structural materials near the core were significantly modified. This resulted in altered radiation spectra at normal experimental locations and nulli-

fied all previous reference dosimetry. New reference neutron dosimetry has been developed and is presented for the unshielded HPRR as well as for the HPRR in five typical shielded configurations.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 5798

2209 Reactor Safety

REFER ALSO TO CITATION(S) 5550, 5767, 5769, 5784, 6220, 6221, 6222, 6223, 6224, 6225, 6226, 6227, 6435, 6570

5794 (ANL/EES-TM—291, pp 1-9) **Post-accident recovery operations at TMI-2.** Merchant, D.J.; Tarpinian, J.E. (GPU Nuclear Corp., Middletown, PA; Bechtel National Inc., Oak Ridge, TN). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

The accident at Three Mile Island Unit 2 resulted in severe radiological conditions in many areas of the station. Personnel entry into some of these areas was required to stabilize the plant. Mobile teleoperators were not utilized at the time because available machines lacked the required degree of sophistication and versatility. Personnel radiation exposures may have been significantly reduced had devices designed to perform certain tasks been available for immediate use. This paper reviews the immediate post-accident recovery tasks and provides functional criteria for the development of teleoperators that could perform similar tasks in high-radiation environments in the future. 4 refs. (TEM)

5795 (ANL/EES-TM—291, pp 49-60) **The TMI-2 remote technology program.** Bengel, P.R. (Bechtel Corp., Middletown, PA). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

Since the accident at Three Mile Island Unit 2 (TMI-2), an aggressive approach has been pursued in developing the tools needed for the recovery of the plant. The plant's owner has embarked on a systematic program to develop remote equipment. The program developed conceptual and then physical equipment. The remote reconnaissance vehicles (RRVs) and the remote working vehicle (RWV) span the requirements of the recovery program from the ability to perform radiological and video surveys to heavy-duty decontamination and demolition work. 4 figs.

5796 (ANL/EES-TM—291, pp 121-130) **Mobile teleoperator research at Savannah River Laboratory.** Byrd, J.S. (Savannah River Lab., Aiken, SC). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

A Robotics Technology Group employs modern automation and robotics for applications at the Savannah River site. Several industrial robots have been installed in plant processes and other robotics systems are under development in the laboratories, including mobile teleoperators for general remote tasks and emergency response operations. This paper discusses present work on a low-cost wheeled mobile vehicle, a modular light-duty manipulator arm, a large gantry telerobot system, and a high-technology six-legged walking robot with a teleoperated arm. 5 refs., 6 figs.

5797 (CONF-8710111—6) **The impact of BWR MK I primary containment failure dynamics on secondary containment integrity.** Greene, S.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002534/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During the past four years, the ORNL BWRSAT Program has developed a series of increasingly sophisticated BWR secondary containment models. These models have been applied in a variety of studies to evaluate the severe accident mitigation capability of BWR secondary containments. This paper describes the results of a recent ORNL study of the impact of BWR MK I primary containment failure dynamics on secondary containment integrity. A 26-cell MELCOR Browns Ferry secondary containment model is described and the predicted thermodynamic response of the secondary containment to a variety of postulated primary containment failure modes is presented. The effects of primary containment failure location, timing, and ultimate hole size on secondary containment response is investigated, and the potential impact of hydrogen deflagrations on secondary containment integrity is explored.

5798 (DOE/ER/35012—T1) **Safety issues at the defense production reactors.** (National Research Council, Washington, DC (USA). Committee to Assess Safety and Technical Issues at DOE Reactors). 1987. Contract FG01-86ER35012. 277p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88001899/JAW.

The United States produces plutonium and tritium for use in nuclear weapons at the defense production reactors - the N Reactor in Washington and the Savannah River reactors in South Carolina. This report reaches general conclusions about the management of those reactors and highlights a number of safety and technical issues that should be resolved. The report provides an assessment of the safety management, safety review, and safety methodology employed by the Department of Energy and the private contractors who operate the reactors for the federal government. This report examines the safety objective established by the Department of Energy for the production reactors and the process the Department of its contractors use to implement the objective; focuses on a variety of uncertainties concerning the production reactors, particularly those related to potential vulnerabilities to severe accidents; and identifies ways in which the DOE approach to management of the safety of the production reactors can be improved.

5799 (DOE/NE/37970—1) **The Pennsylvania State University Light Water Ultra-Safe Plant Concept: 3rd quarter progress report.** Klevans, E. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). 1 Jul 1987. Contract AC02-86NE37970. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001398/JAW.

Progress in the Ultra Safe study has substantially increased since the last report. The search for pressurizing pump turbine component information is now complete and a final plant layout for detailed evaluation has been chosen. Significant results for the normal operation performance of the Ultra Safe pressurizing technique are included. The plan of attack for the evaluation of the Ultra Safe shutdown scenario and natural circulation capability is discussed. This process is expected to be the next key area for analysis. The reactor design is complete including a change to alleviate the need for a soluble boron system. Material on the reactor building layout is also provided.

5800 (DOE/NE/37970—2) **Light water ultra-safe plant concept: First annual report.** Klevans, E. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). 19 Oct 1987. Contract AC02-86NE37970. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001682/JAW.

Since the accident at Three Mile Island (TMI) Penn State Nuclear Engineering Department Faculty and Staff have considered various methods to improve already safe reactor designs and public perception of the safety of Nuclear Power. During the last year, the Department of Energy funded the study of a plant reconfiguration originally proposed by M.A. Shultz. This report presents the status of the project at the end of the first year. A broad set of specifications to improve safety and public perception were set forth and the realization of these goals is achieved in a plant design named, "The Light Water Ultra-Safe Plant Concept." The most significant goals of the concept address the station black-out problem and simplification of required operator actions during abnormal sit-

uations. These goals are achieved in the Ultra-Safe Concept by addition of an in-containment atmospheric tank containing a large quantity of cool water, replacement of the conventional PWR pressurizer system with a pressurizing pump, internal emergency power generation, and arrangement of components to utilize natural circulation at shut-down. The first year effort included an evaluation of the normal operation characteristics of the primary system pressurizing concept, evaluating parameters and modeling for analysis of the shutdown scenario, design of a low power density core, design of a low-pressure waste handling system, arrangement of a drainage system for pipe break considerations, and failure modes and effects analysis.

5801 **(DOE/NE/37970—2-Add.1) Mechanical spectral shift reactor for a light water ultra-safe plant concept.** Klevans, E.H.; Edlund, M. (Pennsylvania State Univ., University Park (USA)). [1987]. Contract AC02-86NE37970. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001684/JAW.

This report presents the detailed results of the reactor core design study for the light water ultra-safe plant concept evaluation funded by Department of Energy (DOE) Contract No. AC02-86NE37970. The annual report for the plant concept, of which the reactor core design is a part, contains a summary of this more exhaustive report on the core design. A premise of the plant concept is that the reactor core on future plants should be designed for lower power density operation in order to provide a larger margin of safety during upset conditions. The ultra-safe core design provides an economical low power density core design by using the mechanical spectral shift principle. Improved economics is achieved by increasing the conversion ratio of fertile fuel by adjusting the fuel-to-water ratio during the extended 4-year fuel cycle. Adjustment of the fuel-to-water ratio over core life also provides a lower excess reactivity, resulting in elimination of the need for a soluble boron system.

5802 **(DOE/NE/37970—2-Add.2) Waste handling and drainage system for a light water ultra-safe plant concept: Addendum to annual report.** Klevans, E.; Schultz, M.A. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). 19 Oct 1987. Contract AC02-86NE37970. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001683/JAW.

This addendum describes the gas cleanup and coolant loss handling configuration (drainage) of the ultra-safe PWR, a plant whose characteristics are described in the annual report on the "Light Water Ultra-Safe Plant Concept," DOE Contract No. AC02-86NE37970. This drainage system may be appropriate to incorporate into advanced PWR concepts developed by other sources.

5803 **(EGG-M—06886) Creep rupture failure of reactor pressure vessel lower head during severe accidents.** Shah, V.N. (EG and G Idaho, Inc., Idaho Falls (USA)). 12 Sep 1986. Contract AC07-76ID01570. 5p. (CONF-860908—45). NTIS, PC A02. Order Number DE88002200/JAW.

From Operability of nuclear power systems in normal and adverse environments meeting; Albuquerque, NM, USA (29 Sep 1986).

A creep rupture analysis of a reactor pressure vessel lower head subjected to high temperature and pressure during a severe accident is presented herein. Preliminary results show that creep rupture failure will take place at temperatures of approximately 1000°K. These temperatures are significantly lower than the melting temperatures of steel (1700 to 1800°K) when the system pressure is high (6.8 to 13.8 MPa).

5804 **(EGG-M—22186) SCDAP/RELAP5 update and applications.** Allison, C.M.; Berna, G.A.; Cheng, T.C.; Siefken, L.J.; Shieh, A.S.L.; Wagner, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 6p. (CONF-8610135—65). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87012434/JAW.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The integrated SCDAP/RELAP5 code is being developed by the Office of Nuclear Regulatory Research of the USNRC for the purpose of calculating the core damage and fission product transport within the RCS during LWR severe accidents events. Activities since October 1985 were concentrated in three areas. The first area, code and model development, resulted in the addition of a B_4C control rod model and a two-dimensional (axial-radial) heat conduction analysis of fuel and control rods. The second area, developmental assessment, evaluated code models using the results of the OECD LOFT FP-2 test and the PBF and ACRR severe fuel damage tests. The third area, user and NRC technical support, resulted in application of the code to analyses of severe accidents in BWRs and PWRs. 8 refs.

5805 **(EGG-TMI—7785) Assessment of TMI-2 I and Cs chemistry during core degradation.** Cronenberg, A.W.; Langer, S. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88002202/JAW.

Data from the TMI-2 accident has shown that only small amounts of iodine and cesium escaped the plant, on the order of tens of curies. A detailed investigation of fission product I and Cs behavior during the core degradation phase of the TMI-2 accident was initiated. Specifically, analyses are presented of I and Cs release from the severely damaged fuel, chemical reaction processes with the steam/hydrogen effluent, and transport/deposition behavior within the primary coolant system. Results indicate that, although elemental I and Cs release from fuel can be expected, the effluent chemical environment was such as to favor predominantly CsI and CsOH formation in the high-temperature effluent. Subsequent CsI reaction with boric acid released with reflood water is predicted to have resulted in partial conversion of CsI to Cs-borate and HI. Residual transport of CsI is predicted to condense and chemisorb in the upper reactor plenum, forming additional HI in the process. HI is, therefore, assessed to be the principal form of iodine transport leaving the reactor vessel during core degradation, which was subsequently dissolved in water to produce iodide ions in solution with coolant. 19 figs., 24 tabs.

5806 **(EGG-TMI—7811) Thermal interaction of core melt debris with the TMI-2 baffle, core-former, and lower head structures.** Cronenberg, A.W.; Tolman, E.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002192/JAW.

Recent inspection of the TMI-2 core-former baffle walls (vertical), former plates (horizontal), and lower plenum has been conducted to assess potential damage to these structures. Video observations show evidence of localized melt failure of the baffle walls, whereas fiberoptics data indicate the presence of resolidified debris on the former plates. Lower plenum inspection also confirms the presence of 20 tons or more of core debris in the lower plenum. These data indicate massive core melt relocation and the potential for melt attack on vessel structural components. This report presents analyses aimed at developing an understanding of melt relocation behavior and damage progression to TMI-2 vessel components. Thermal analysis indicates melt-through of the baffle plates, but maintenance of structural integrity of the former plates and lower head. Differences in the damage of these structures is attributed largely to differences in contact time with melt debris and pressure of water. 29 refs., 17 figs., 9 tabs.

5807 **(EGG-TMI—7833) Recommended HPI [High Pressure Injection] rates for the TMI-2 analysis exercise (0 to 300 minutes).** Anderson, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002193/JAW.

An international analysis exercise has been organized to evaluate the ability of nuclear reactor severe accident computer codes to predict the TMI-2 accident sequence and core damage progression during the first 300 minutes of the accident. A required boundary condition for the analysis exercise is the High Pressure Injection or make-up rates into the primary system during the accident. Recommended injection rates for the first 300 minutes of the accident are presented. Recommendations for several sensitivity studies are also presented. 6 refs., 5 figs., 1 tab.

5808 **(EGG-TMI—7851) TMI-2 fission product inventory estimates (draft).** Tolman, E.L.; Nishio, M. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88002191/JAW.

This report presents the results of analyses performed to estimate the inventory and distribution of selected radioisotopes within the TMI-2 reactor system. The intent of the report is to document the method used in estimating the fission product inventory and associated uncertainties. The values presented should be viewed as preliminary. Seiected radioisotopes for which best-estimate inventories and uncertainties are presented include: Krypton (Kr-85), Cesium (Cs-137), Iodine (I-129), Antimony (Sb-125), Ruthenium (Ru-106), Strontium (Sr-90), Cerium (Ce-144), and Europium (Eu-154). The TMI-2 inventory data will provide a basis for relating the fission product behavior during a large-scale severe accident to smaller-scale experimental data and fission product behavior modeling work. This is an important link in addressing the many technical questions that relate to core damage progression and fission product behavior during severe accidents. 11 refs., 7 figs., 15 tabs.

5809 **(EPRI-NP—5158) Proceedings: 1985 workshop on primary-side stress corrosion cracking of PWR steam generator tubing.** Stein, A.A.; McIlree, A.R. (ed.). (Stone and Webster Engineering Corp., Boston, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 553p. (CONF-8503284—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW.

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

This workshop was held to collect current data on the experience with primary water stress corrosion cracking (PWSCC) of steam generator tubing and the related laboratory investigations. Thirty-two presentations were given covering field experience, correlations of laboratory data to the field, and relationship of material microstructure, stress, and environment to PWSCC. The emphasis of the workshop was more on the fundamentals associated with PWSCC yet culminated with several presentations on remedial measures.

5810 (EPRI-NP—5158, pp 1.1-1.35) **Tubesheet and expansion transition cracking at Doel 3 and Tihange 2.** Frederick, G.; Hernalsteen, P. (Belgatom, Brussels, Belgium). Jun 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920465/JAW. (CONF-8503284—).

From Workshop on primary-side stress corrosion cracking of PWR steam generator tubing; San Diego, CA, USA (20 Mar 1985).

The field experience from Doel 2, Doel 3, and Tihange-2 shows that mill-annealed Alloy 600 tubes may be very susceptible to primary water stress corrosion cracking in the tubesheet area, both in the roll transition and the expanded area for the full thickness of the tubesheet. Cracks initiate at areas of high residual stress resulting from mechanical or hydraulic expansion. These areas include the roll transition (with or without a kiss roll), areas of major rolling anomalies, and also areas of minor discontinuities, even those which are considered acceptable (and are practically unavoidable) by normal manufacturing practices. A large number of cracked tubes may not be noticed by the normal inspection methods and may lead to only very small service leaks. Thus, many units with mill-annealed Alloy 600 tubing might be affected by an undetected stress corrosion problem. The long-term operational and safety significance of the degradation progress is an unclear issue. An extensive R & D program has been launched to identify appropriate preventive and corrective actions for the 4 recent Belgian units (Doel 3 and 4, and Tihange 2 and 3). A full-length rotopeening has already been performed in the tubesheet areas of the units Doel 4 and Tihange 3.

5811 **(EUR—10660) Theoretical investigations on the fragmentation of drops of melt with respect to the description of thermal detonations (vapor explosions) and their application in the code Frademo.** Burger, M.; Carachalios, C.; Kim, D.S.; Unger, H. (Commission of the European Communities, Luxembourg). 1986. 279p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750628/JAW.

Vapor explosions caused by the contact of molten core material with coolant are an important issue within reactor safety analysis, because they could produce an early threat to the containment during a core melt accident. The case of steady-state propagation of a detonation wave through a coarse premixture of melt and coolant represents the most severe case of a large scale vapor explosion under reactor conditions with the highest rate and largest heat release and therefore also the highest yield of mechanical energy. The present contribution starts with the description of the integral model of the detonation wave. The fragmentation processes, which are decisive for these exchange terms and the detonation process as a whole, are dealt with also. Hydrodynamic fragmentation processes as well as a thermally induced one are considered. The processes which take place inside a detonation wave, especially the fragmentation of the drops of melt and the velocity equilibration between the melt and the coolant, determine the behavior of the wave. In the present model these processes are described within a three-phase approach, considering the drops of melt, the fragments and the coolant as separate flow phases. In the frame of this work, the computer code FRADEMO has been developed. It consists of an overall description of the processes inside a steady-state detonation wave in combination with a full description of the detailed models on hydrodynamic and thermal fragmentation presented in this report. Some useful information for the potential code user is given in the appendix of the detailed report also.

5812 **(EUR—10696-1) Systems reliability Benchmark exercise. Part 1. Description and results.** Amendola, A. (ed.). (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 181p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750630/JAW.

The report describes aims, rules and results of the Systems Reliability Benchmark Exercise, which has been performed in order to assess methods and procedures for reliability analysis of complex systems and involved a large number of European organizations active in NPP safety evaluation. The exercise included both qualitative and quantitative methods and was structured in such a way that separation of the effects of uncertainties in modelling and in data on the overall spread was made possible. Part I describes the way in which RBE has been performed, its main results and conclusions.

5813 **(EUR—10696-2) Systems reliability Benchmark exercise. Part 2. Contributions by the participants.** Amendola, A. (ed.). (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 315p. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88750629/JAW.

The report describes aims, rules and results of the Systems Reliability Benchmark Exercise, which has been performed in order to assess methods and procedures for reliability analysis of complex systems and involved a large number of European organizations active in NPP safety evaluation. The exercise included both qualitative and quantitative methods and was structured in such a way that separation of the effects of uncertainties in modelling and in data on the overall spread was made possible. This second part of the report is devoted to the documentation of the single contributions by the participant teams (Swedish, GRS, ENEA, NIRA and ENEL, EWE, EdF, Risoe, KWU/IA, ECN, KEMA/KUL, and Framatome contributions).

5814 **(GEND-INF—081) Examination of concrete samples from the TMI-2 reactor building basement.** Akers, D.W.; Roybal, G.S. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1987. Contract AC07-76ID01570. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002201/JAW.

Core samples were obtained from the concrete walls of the TMI-2 reactor building basement which had been submerged for up to three years in reactor coolant which leaked from the damaged reactor. The concrete samples were obtained in 1985 and 1986 using a Rover robot equipped with a drilling attachment. Three samples were sent to the Idaho National Engineering Laboratory (INEL) for examination to determine the leachability and total re-

tention of fission products in the concrete. These data are to be used in the evaluation of methods for decontaminating the reactor building basement. It was determined that for some radionuclides (e.g., ^{90}Sr) up to 90% of the total activity can be removed by leaching. 11 refs., 10 figs., 3 tabs.

5815 **(GRS-F—158) Surveys of research projects concerning nuclear facility safety, financed by the Federal Ministry for the Environment, Nature Protection and Reactor Safety. 11. annual report on SR-projects 1986.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1987. 257p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750537/JAW.

Each progress report is a collection of individual reports, categorized by subject matter. They are a documentation of the contractor's progress, rendered by themselves on standardized forms, published, for the sake of general information on progress made in investigations concerning reactor safety, by the project attendance department of the GRS. The individual reports have serial numbers. Each report includes particulars of the objective, work carried out, results obtained and plans for project continuation.

5816 **(GRS-F—161) List of reports in the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reported period: April 1-June 30, 1987. Progress report.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Aug 1987. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750557/JAW.

The list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of reactor safety research. According to the cooperation of the Federal Minister for Research and Technology (BMFT) with the Commissariat a l'Energie Atomique (CEA), the Japan Science and Technology Agency (JSTA), the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission, these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programme of the BMFT, reporting organization. The list of reports appears quarterly.

5817 **(KFK—4253) New determination of the UO/sub 2//Zircaloy reaction kinetics and calculation of the oxygen diffusion coefficients.** Hofmann, P.; Uetsuka, H.; Garcia, E.; Denis, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Materiales). Jun 1987. 56p. (CNEA-NT—33/86). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750556/JAW.

The results of the isothermal UO/sub 2//Zircaloy interaction experiments were corrected with respect to the actual annealing temperature and the reaction time. This was done by comparison of the ZrO/sub 2/ and α-Zr(O) reaction layer thicknesses of the UO/sub 2//Zircaloy fuel rod segments, which reacted under oxidizing conditions, with that of Zircaloy cladding oxidation experiments performed in a tube furnace under well controlled temperature conditions. The reactions which took place during the heatup and cooldown period were taken into consideration by the determination of a so-called equivalent isothermal annealing time which was added to the actual isothermal annealing time. The resulting new Arrhenius equations, describing the growth rate of the various UO/sub 2//Zircaloy interaction layers, indicate smaller rates below 1300degC and higher rates above about 1300degC compared to the uncorrected data. The growth rates for the external ZrO/sub 2/ and α-Zr(O) reaction layers remained unchanged. The corrected Arrhenius equations were used to determine the effective oxygen diffusion coefficient in the various reaction layers. A good agreement between the experimental data and the results of the model was finally achieved using the new effective oxygen diffusion coefficients. The Arrhenius equations for the oxygen diffusion coefficients along with the functions fitted for the oxygen concentration at the phase boundaries also allow the calculation of the UO/sub 2//Zircaloy interactions during temperature transients.

5818 **(KFK—4285) DEMONA annual report 1986.** Schoeck, W. (comp.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1; Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.); Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jul 1987. 81p. (In German). (BF-R—65.523-13; EIR—621; GRS-A—1344; KWU-R—917/87/112). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750546/JAW.

The DEMONA program is conducted to DEMOnstrate Nuclear Aerosol behavior in large scale experiments. It is to be shown that the NAUA aerosol code is capable of describing sufficiently well the typical aerosol behavior during accidents in pressurized water reactors. DEMONA will also contribute to the validation of the thermodynamics codes COCMEL and FIPLOC. The experiments are carried out in the model containment facility at Battelle Frankfurt which is a quarter scale model of the Biblis A containment. The geometric and thermodynamic properties of the model containment allow a realistic simulation of the conditions during core melt accidents. In 1986, the two remaining experiments of the test matrix were carried out and evaluated. In this report the work performed and the main results are summarized.

5819 **(NUREG/CR—4550-Vol.1) Analysis of core damage frequency from internal events: Methodology guidelines: Volume 1.** Drouin, M.T.; Harper, F.T.; Camp, A.L. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 292p. (SAND—86-2084-Vol.1). NTIS, PC A13/MF A01 - GPO. Order Number TI88002525/JAW.

NUREG-1150 examines the risk to the public from a selected group of nuclear power plants. This report describes the methodology used to estimate the internal event core damage frequencies of four plants in support of NUREG-1150. In principle, this methodology is similar to methods used in past probabilistic risk assessments; however, based on past studies and using analysts that are experienced in these techniques, the analyses can be focused in certain areas. In this approach, only the most important systems and failure modes are modeled in detail. Further, the data and human reliability analyses are simplified, with emphasis on the most important components and human actions. Using these methods, an analysis can be completed in six to nine months using two to three full-time systems analysts and part-time personnel in other areas, such as data analysis and human reliability analysis. This is significantly faster and less costly than previous analyses and provides most of the insights that are obtained by the more costly studies. 82 refs., 35 figs., 27 tabs.

5820 **(NUREG/CR—4963) Boron carbide: Steam reactions with cesium hydroxide and with cesium iodide at 1270K in an Inconel 600 system.** Elrick, R.M.; Sallach, R.A.; Ouellette, A.L. Douglas, S.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 82p. (SAND—87-1491). NTIS, PC A05/MF A01 - GPO. Order Number TI88002650/JAW.

Three laboratory scale tests examined the effect of boron carbide, used for the control of some nuclear power reactors, on reactor accident conditions. The tests, conducted in steam at 1270°K in an Inconel 600 system, examined the boron carbide-steam system and then that system with an addition of cesium hydroxide or cesium iodide vapor. Extensive reaction was demonstrated between the boron carbide and steam to produce B_2O_3 and boric acids in a two step kinetic process. Average rates of production for the oxide and acids were calculated for the three tests. These rates are functions of time, temperature, B_4C geometry, and partial pressure of the steam and the boric acid. Significant reactions were observed between the boric oxide formed on the B_4C and both the CsOH vapor and the CsI vapor, dissociating the cesium and iodine in the latter case. The cesium reaction product in both cases was probably $CsBO_2$, with the iodine forming HI. Surface reaction rate constants were estimated for the CsOH and the CsI reactions.

5821 (NUREG/CR—5010) RELAP5/MOD2 assessment using semiscale experiments S-NH-1 and S-LH-2. Yuann, Ruey-ying; Liang, Kuo-shing; Jacobson, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1987. Contract AC07-76ID01570. 69p. (EGG—2520). NTIS, PC A04/MF A01 - GPO. Order Number TI88002541/JAW.

This report presents the results of the RELAP5/MOD2 posttest assessment utilizing two small break loss-of-coolant accident (LOCA) tests (S-NH-1 and S-LH-2) which were performed in the Semiscale Mod-2C facility. Test S-NH-1 was a 0.5% small break LOCA where the high-pressure injection system (HPIS) was inoperable throughout the transient. Test S-LH-2 was a 5% small break LOCA involving a relatively high upper-head-to-downcomer initial bypass flow and nominal emergency core cooling. Through comparisons between data and best-estimate RELAP5 calculations, the capabilities of RELAP5 to calculate the transient phenomena are assessed. For S-NH-1, emphasis was placed on the capability of the code to calculate various operator actions to initiate core heatup in the absence of HPIS. For S-LH-2, the capability of the code to calculate basic small break system response, such as vessel level during loop seal formation and clearing, break uncovery, and primary pressure response following accumulator injection, was assessed. 10 refs., 76 figs., 4 tabs.

5822 (OUP—87-24) Fallout and radiation doses in Norway after the Chernobyl accident. Henriksen, T.; Saxeboel, G. (Oslo Univ. (Norway). Fysisk Inst.). Aug 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750356/JAW.

Due to southeasterly wind and rainfall during the critical days after the Chernobyl accident, Norway got a substantial part of the cesium isotopes released. The radioactive fallout followed closely the rainfall and was mainly concentrated to some thin populated areas in the central parts of the country. The total fallout of the cesium isotopes was approximately 2300 TBq (Cs-137) and 1200 TBq (Cs-134). The average for the country was 11 kBq/m/sup 2/ with a variation from 1.5 to 40 kBq/m/sup 2/ for the 19 different counties of the country. The fallout resulted in contamination of food products from some areas, mainly meat from reindeer and sheep, as well as freshwater fish. A small fraction of the food produced in 1986 was not sold due to the regulations enforced. The average radiation dose to the Norwegian population during the first year after the accident was approximately 0.3 mSv (0.1 mSv from external radiation and about 0.2 mSv from foodstuff). This first year extra dose is approximately 5% of the average normal background dose in Norway.

5823 (PNL-SA—15146) US extension of indemnification to utilities and contractors. Cunningham, G.H. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 12p. (CONF-8709168—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001902/JAW.

From 8. conference of the International Bar Association on business law; London, UK (17 Sep 1987).

This paper presents a review of the Price-Anderson Act. Also discussed is 1987 congressional debate concerning the future of the Act. The major area of debate is the issue of "contractor accountability" for idemnified Department of Energy contractors. (JDH)

5824 (SAND—87-2330C) MELPROG analysis of the debris formation experiment DF-1. Heames, T.J.; Gauntt, R.O. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 32p. (CONF-8710111—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002411/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The MELPROG code is being developed jointly at Sandia National Laboratories and Los Alamos National Laboratory to provide the US Nuclear Regulatory Commission (USNRC) with an integrated analysis model for light water reactor (LWR) severe fuel damage (SFD) accidents. MELPROG is a mechanistic code, based upon detailed physics models, that will calculate the progression of a core uncovered accident including the multidimensional thermal hydraulics, core degradation, loss of geometry, melting of the core rods, debris formation, radionuclide release and transport, attack of the support structure, core slumping, melt-water interactions, and vessel failure. Additionally MELPROG can be coupled to the TRAC code to treat fission product transport and the thermal hydraulics of the reactor coolant system (RCS). As part of this development effort, the phenomenological modelling in the code is undergoing extensive assessment. This assessment effort involves comparing the data from experimental programs with code predictions to validate the models used and to identify areas of needed model improvement. An important component of this effort is the assessment of the models used to describe the fuel rod heat-up, melting, and relocation phases of an uncovered accident. The Damaged Fuel (DF) experiments are examples of experiments being performed to address these issues. This paper describes a posttest MELPROG analysis of the first of these tests. 6 refs., 9 figs., 2 tabs.

5825 DEFORM-4: fuel pin characterization and transient response in the SAS4A accident analysis code system. Miles, K.J.; Hill, D.J. (Argonne National Lab., IL, USA). pp 51-58 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

The DEFORM-4 module is the segment of the SAS4A Accident Analysis Code System that calculates the fuel pin characterization in response to a steady state irradiation history, thereby providing the initial conditions for the transient calculation. The various phenomena considered include fuel porosity migration, fission gas bubble induced swelling, fuel cracking and healing, fission gas release, cladding swelling, and the thermal-mechanical state of the fuel and cladding. In the transient state, the module continues the thermal-mechanical response calculation, including fuel melting and central cavity pressurization, until cladding failure is predicted and one of the failed fuel modules is initiated. Comparisons with experimental data have demonstrated the validity of the modeling approach.

5826 Fuel relocation modelling in the SAS4A accident analysis code system. Tentner, A.M.; Miles, K.J.; Kalimullah; Hill, D.J. (Argonne National Lab., IL, USA). pp 85-90 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

The SAS4A code system has been designed for the analysis of the initial phase of Hypothetical Core Disruptive Accidents (HCDAs) up to gross melting or failure of the subassembly walls. During such postulated accident scenarios as the Loss-of-Flow (LOF) and Transient-Overpower (TOP) events, the relocation of the fuel plays a key role in determining the sequence of events and the amount of energy produced before neutronic shutdown. This paper discusses the general strategy used in modeling the various phenomena which lead to fuel relocation and presents the key fuel relocation models used in SAS4A. The implications of these models for the whole-core accident analysis as well as recent results of fuel motion experiment analyses are presented. The inherent safety aspects related to the pre-failure fuel relocation are emphasized.

5827 Experimental studies of heat removal from fission-heated UO_2 debris in sodium. Mitchell, G.W.; Rivard, J.B.; Hitchcock, J.T. (Sandia National Labs., Albuquerque, NM, USA). pp 253-258 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

A joint program to study the coolability of debris beds formed under reactor accident conditions was sponsored by the USNRC. JRC of the European Communities, and PNC Japan. The program, conducted at Sandia National Laboratories, was completed in 1985. This paper provides a review of the program's twelve in-pile experiments and the data obtained from those experiments. These are the first coolability experiments to be conducted in-pile using internally-heated urania in sodium.

5828 **Comments on the possible roles of volatile fission products (cesium) in CABRI tests.** Lumpkin, A.H. (Los Alamos National Lab., NM, USA). pp 419-426 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

An investigation of information within the CABRI program that relates to the possible roles of volatile fission products (as represented by cesium) will be described. This study was partially motivated by the observation of localized ^{137}Cs concentration peaks in the axial gamma scans of pins pre-irradiated to about 5% burnup (BU) level. In order to evaluate potential effects of such concentrations, a re-examination of the existing test data for the 1% BU pins was performed. A comparison of CABRI hodoscope fuel motion results and the pre-CABRI ^{137}Cs axial concentration profiles revealed an approximate spatial correlation between the initial points of fuel dispersal and cesium concentration enhancements (seven of eight cases).

5829 **In-pile fuel freezing and penetration experiments - the ACRR TRAN experiments.** Gauntt, R.O.; Pickard, P.S.; Berthier, J.; Furutani, A.; Royl, P. (Sandia National Labs., Albuquerque, NM, USA; CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance, France; Power Reactor and Nuclear Development Corp., Oarai, Ibaraki, JP; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). pp 433-438 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

The TRAN series of experiments focus on providing a data base for the evaluation of models of fuel removal phenomena during the transition phase of a CDA (Core Disruptive Accident). Series I (5 tests) provided data for comparisons with existing analytic models of fuel freezing. The B-series (4 tests) focused on fuel removal through upper blanket structures. The GAP test involved a 1.7 Kg UO_2 melt to examine the potential for fuel removal through subassembly gaps. The TRAN tests showed a modified conduction model valid over a wide range of temperature, pressure and geometries. Based on these results, significant fuel removal is expected under many conditions in the transition phase of an LMFBR CDA.

5830 **In-pile observations of fuel and clad relocation during LMFBR initiation phase accident experiments - the STAR experiments.** Wright, S.A.; Schumacher, G.; Henkel, P.R.; Royl, P. (Sandia National Labs., Albuquerque, NM, USA; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). pp 439-444 of Science and technology of fast reactor safety. Vol. 2. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; British Nuclear Energy Society (1987). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Pound 150.

A series of seven in-pile experiments (the STAR experiments) were performed in which clad motion and fuel dispersal were observed in small pin bundles with high-speed cinematography. The experimental heating conditions reproduced a range of Loss of Flow (LOF) accident scenarios for the lead subassemblies in LMFBRs. The experiments show strong tendencies for limited clad motion in multiple pin bundles, early fuel disruption and dispersal (prior to fuel melting) in moderate power transients having simultaneous clad melting and fuel disruption. The more recent experiments indicate a possibility of steel vapor driven fuel dispersal after fuel breakup and intimate fuel/steel mixing.

5831 **Health physics considerations for the Compact Ignition Tokamak.** Stencel, J.R.; Fleming, R.B.; Commander, J.; McKenzie-Carter, M. (Princeton Plasma Physics Lab., Princeton, NJ 08544). pp 356-364 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—). Contract AC02-76CH03073.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The Compact Ignition Tokamak (CIT) is a new fusion experiment that is being considered for the next major step in the United States fusion effort. The experiment features an ignition machine which will use tritium as a fuel, a tritium inventory on the order of 10 to 20 grams, and will produce a significant number of high energy (14 MeV) neutrons. This paper discusses this new experiment, the proposed facilities, the safety features, and protective measures to be utilized to limit release of tritium and activated air to the environment, to limit direct radiation beyond the controlled area boundary, and to assure safety levels of radiation exposure to operating personnel.

5832 **Characteristics of Chernobyl radioactivity in Tennessee.** Bondietti, E.A.; Brantley, J.N. (Oak Ridge National Lab., TN, USA). *Nature (London);* **322**: No. 6077, 313-314(24 Jul 1986).

The paper reports the characteristics of fission product radioactivity as detected in Tennessee, USA, April-June 1986, attributed to Chernobyl reactor fallout. Data on ^{137}Cs: fission product ratios, measured in air and precipitation are given. The mean aerodynamic sizes of aerosol-associated fission products reaching Tennessee were also determined.

5833 **Overview of fast reactor safety research and development in the USA.** Neuhold, R.J.; Avery, R.; Marchaterre, J.F. (Department of Energy, Washington, DC, USA; Argonne National Lab., IL, USA). pp 9-12 of Science and technology of fast reactor safety. Vol. 1. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; BNES (1986). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

The liquid metal reactor (LMR) safety RandD program in the U.S. is presently focused on support of two modular innovative reactor concepts: PRISM - the General Electric Power Reactor Inherently Safe Module and SAFR - the Rockwell International Sodium Advanced Fast Reactor. These reactor plant concepts accommodate the use of either oxide fuel or the metal fuel which is under development in the Argonne National Laboratory (ANL) Integral Fast Reactor (IFR) program. Both concepts emphasize prevention of accidents through enhancement of inherent and passive safety characteristics. Enhancement of these characteristics is expected to be a major factor in establishing new and improved safety criteria and licensing arrangements with regulatory authorities for advanced reactors. Limited work is also continuing on the Large Scale Prototype Breeder (LSPB), a large pool plant design. Major elements of the current and restructured safety program are discussed.

5834 **Progress and future plans in the PFR/TREAT safety testing programme.** Alter, H.; Cowking, C.B.; Klickman, A.E.; Wood, M.H. (Department of Energy, Washington, DC, USA; UKAEA Risley Nuclear Power Development Establishment; Argonne National Lab., IL, USA; UKAEA Atomic Energy Establishment, Winfrith). pp 21-26 of Science and technology of fast reactor safety. Vol. 1. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; BNES (1986). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

This paper briefly describes the progress to date on the joint UKAEA/USDOE program of fast reactor fuel safety testing and the definition of the future tests. The program involves transient tests in the TREAT reactor on fresh and irradiated mixed oxide fuel pins. The tests simulate transient overpower (TOP) accidents, which result from an unintentional addition of reactivity and transient undercooling followed by overpower (TUCOP) accidents, which arise from an unintentional stoppage of the primary sodium circulating pumps, both with failure to scram. Thirteen tests have been performed to date, all on UK pins. Future plans include five tests, all on US pins which have been irradiated in FFTF. Much has been learned about the behavior of fuel driven to conditions well beyond those existing during normal reactor operation.

5835 **Post-failure material movement in the PFR/TREAT experiments.** Bauer, T.H.; Morman, J.A.; Hill, D.J.; Devolpi, A.; Goldman, A.J.; Cooper, A.A.; Davies, A.L. (Argonne National Lab., IL, USA; UKAEA Atomic Energy Establishment, Winfrith). pp 33-40 of Science and technology of fast reactor safety. Vol. 1. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; BNES (1986). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

In the PFR/TREAT experiments the fast neutron hodoscope has provided experimental data on post-failure material movement during Transient Overpower and Transient Under-Cooled Overpower events. Analyses of selected experiments have been done, using SIMMER-II and SAS4A, to validate these codes. Full results of these analyses are presented in the paper. The general conclusion that can be drawn from the analyses that have been made so far is that the hodoscope is providing data which has appropriate resolution in time and space and that the computer models which are being used by the USDOE and the UKAEA provide good representations of fuel redistribution.

5836 **Recent metal fuel safety tests in TREAT.** Wright, A.E.; Bauer, T.H.; Lo, R.K.; Robinson, W.R.; Palm, R.G. (Argonne National Lab., IL, USA). pp 59-64 of Science and technology of fast reactor safety. Vol. 1. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; BNES (1986). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

In-reactor safety tests have been performed on metal-alloy reactor fuel to study its response to transient-overpower conditions, in particular, the margin to cladding breach and the axial self-extrusion of fuel within intact cladding. Uranium-fissium EBR-II driver fuel elements of several burnups were tested, some to cladding breach and others to incipient breach. Transient fuel motions were monitored, and time and location of breach were measured. The test results and computations of fuel extrusion and cladding failure in metal-alloy fuel are described.

5837 **Review of models and codes in the US for analysis of whole-core transients and accidents in fast reactors.** Deitrich, L.W.; Weber, D.P. (Argonne National Lab., IL, USA). pp 219-224 of Science and technology of fast reactor safety. Vol. 1. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; BNES (1986). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

For many years, study of whole-core transients and accidents in fast reactors has been a major element of safety research and development programs in the U.S. Numerous models and computer codes have been developed and validated for use in these studies. Historically, emphasis has been placed on describing the core disruptive accident, but more recently emphasis has shifted to describing accident sequences prior to core disruption, with a focus on modeling the mechanisms which could terminate a sequence prior to core disruption. The major models and codes related to transient and accident analysis are reviewed with discussion of the state of development and validation.

5838 **Status of Argonne National Laboratory out-of-pile investigations of severe accident phenomena for liquid metal reactors.** Spencer, B.W.; Marchaterre, J.F.; Anderson, R.P. (Argonne National Lab., IL, USA). pp 231-238 of Science and technology of fast reactor safety. Vol. 1. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; BNES (1986). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Research addressing LMFBR whole core accidents has been terminated, and there is now emphasis on quantifying reactivity feedbacks, and in particular enhancing negative feedback, so that advanced LMR designs will provide inherently safe operation. The status of recent HCDA-related laboratory research performed at ANL, up to the time that such activities were no longer needed to support CRBR licensing, is described. Included are descriptions of programs addressing sodium channel voiding, fuel sweepout, fuel dispersal and plugging, boiled-up pool, UO_2/sodium FCI, and debris coolability. Descriptions of recent investigations involving the metal fuel/sodium system are also included.

25 ENERGY STORAGE

2501 Magnetic

5839 **Coil protection for a utility scale superconducting magnetic energy storage plant.** Loyd, R.J.; Schoenung, S.M.; Rogers, J.D.; Hassenzahl, W.V.; Purcell, J.R. (Bechtel National, Inc., San Francisco, CA). *IEEE Transactions on Power Electronics;* EC-2: No. 3, 336-342(Sep 1987).

Superconducting Magnetic Energy Storage (SMES) is proposed for electric utility load leveling. Attractive costs, high diurnal energy efficiency (≧92%), and rapid response are advantages relative to other energy storage technologies. The SMES plant design includes a protection system which prevents damage to the magnetic coil if events require a rapid discharge of stored energy. This paper describes the design and operation of the coil protection system, which is primarily passive and uses the thermal capacity of the coil itself to absorb the stored electromagnetic energy.

2506 Thermal

5840 **(DOE/CE/15195—T9) Containment barrier construction apparatus (CONBARC): Final report, 12/11/84 through 1/31/87.** Cleary, J.M. (Cleary (James M.), Falmouth, MA (USA)). 8 Aug 1987. Contract FG01-85CE15195. 32p. NTIS, PC A03. Order Number DE87013090/JAW.

This report describes the construction of injection wells and horizontal trenches used in an underground thermal energy storage system. The horizontal trenches were produced with a water jet which is the emphasis of this report. 5 refs., 13 figs. (JDH)

2509 Batteries

5841 **(AD-A—184252/5/XAB) Applications of multivalent ionic conductors to polymeric electrolyte batteries. Technical report No. 12, March 1986-August 1987.** Cherng, J.Y.; Owens, B.B.; Smyrl, W.H.; Munshi, M.Z. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 10 Aug 1987. 18p. NTIS, PC A02/MF A01.

The feasibility of solid-state cells based upon lithium ion-conducting polymer electrolytes has been demonstrated. In this paper a preliminary investigation of sodium and magnesium ion conductors in polymer electrolyte cells is summarized. Cell types were Li/V_6O_{13}, NA/V_6O_{13}, and MG/V_6O_{13} with polymer electrolytes based on polyethylene oxide and salts of the anode element.

5842 **(AD-A—184293/9/XAB) Effects of pressure fluctuations on nickel electrodes. Technical report.** Zimmerman, A.H. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 30 Apr 1987. 40p. (TR—0086A(2945-01)-2). NTIS, PC A03/MF A01.

The rapidly fluctuating pressure environment that exists in today's nickel-hydrogen battery cells during high-rate charge-discharge operation can potentially act as an important source of stress to the active materials in the nickel electrodes. This study examines the coupling between the rapidly fluctuating pressure environment of the nickel-hydrogen cell and degradation of the nickel electrodes arising from expansion and contraction of the active materials. A model is developed to describe this coupling, and the sensitivity of the coupling to the parameters in the model is analyzed. The model is used to determine modes of nickel-hydrogen cell operation for which the pressure environment is particularly critical in terms of potential degradation. The results indicate that cell operation involving rapid cycling or quite large dynamic operating pressure ranges may cause significant stress to the nickel electrodes, and may be an important component in degradation and failure rates. Finally, cell tests are suggested that should allow the effect of the nickel-hydrogen cell pressure environment on performance to be determined.

5843 **(DOE/NV/10509—1) Research and development of advanced lead-acid batteries for electric vehicle propulsion: 1986 annual report, December 1985-March 1987.** Andrew, M.G.; Bowman, D.E. (Johnson Controls, Inc., Milwaukee, WI (USA)). Apr 1987. Contract AC08-86NV10509. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014661/JAW.

Purpose was to develop an advanced lead-acid battery based on the concept of forced flow of electrolyte through porous electrodes for enhanced battery performance 1986. Objectives were: specific energy of 42 Wh/kg, energy density of 70 Wh/l, and cycle life of 100 cycles. Accomplishments were: 35 flow-through cells with reduced construction time, higher fiber content in the positive active materials (PAM) with increased strength by a factor of 3, high-density PAM for increased life without utilization losses, confirmation of solid-state relaxation theory, methods for measuring permeability, 31 cycles achieved in C-450, oxygen recombination in many test cells, electrolyte reservoir can be below the top of the cells, and completed designs for positive and negative flow-through grids and for the injection molds to produce the grid/plastic laminates. 5 figs., 14 tabs. (DLC)

5844 **(N—87-27906) New secondary batteries utilizing electronically conductive polymer cathodes. Final report, 1 September 1986-31 August 1987.** Martin, C.R.; White, R.E. (Texas A and M Univ., College Station (USA)). Aug 1987. 164p. (NASA-CR—181216; NAS—1.26:181216). NTIS, PC A08/MF A01.

The objectives are to optimize the transport rates in electronically conductive polypyrrole films by controlling the morphology of the film and to assess the utility of these films as cathodes in a lithium/polypyrrole secondary battery. During this research period, a better understanding was gained of the fundamental electrochemical switching processes within the polypyrrole film. Three publications were submitted based on the work completed.

5845 **Electrochemical reserve battery.** Koper, K.T.; Willard, S.L.; Abramowski, L. (to Secretary of the Navy, Washington, DC). US Patent 4,695,520. 22 Sep 1987. Filed date 25 Sep 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an electrochemical reserve battery comprising in combination: a housing including a separating wall forming two sealed chambers; a stack of dry cells disposed in one of the chambers; an expandable container occupying a portion of the space within the other of the chambers; an electrolyte completely filling the unoccupied space at a pressure sufficient to collapse the container; a source of high pressure gas within the container; frangible means operatively connected between the source and the container for releasing the gas into the container at a preselected expansion thereof; and actuating means operatively connected to the separating wall for selectively establishing communication between the chambers for permitting the electrolyte to transfer to the cells.

5846 **Impact of mismatched cell characteristics on lead-acid battery charging.** De Luca, W.H.; Tummillo, A.F.; Biwer, R.L.; Yao, N.P. (Argonne National Lab., Argonne, IL). pp 29-36 of Batteries for electric vehicles: Research, development, testing and evaluation. Warrendale, PA; Society of Automotive Engineers (1983). (CONF-8310223—).

From Society of Automotive Engineers meeting; San Francisco, CA, USA (31 Oct 1983).

Technical Paper 830228.

Over the operational life of a battery, the voltage characteristics of its individual cells become mismatched due to differences in self-discharge rates, individual charge efficiency, active material retention, etc. As these cell differences increase, excessive overcharging, operating temperatures, and/or electrolyte consumption result. In a series of tests performed on 6-volt, lead-acid modules, the degree of cell mismatch and the response of the modules to various charge methods were examined. The results show that after about 150 deep-discharge cycles, each module contained at least one cell whose full-charge voltage level was reduced. Prior to any decline in module capacity, cell voltage differences of more than 0.4 V were measured during charge. It was also observed that the application of a fixed battery voltage for charge control eventually caused excessive overcharging, elevated temperatures, and/or an extreme overvoltage condition on individual cells. This paper describes the test procedures employed, presents the test data, discusses the results obtained and solutions being investigated. The data presented from this study show that cell charge-voltage characteristics vary and become mismatched over the operational life of an EE-IV type lead-acid battery.

5847 **How synergetic is a siesta for an electric sedan.** Hornstra, F.; Swoboda, C.; Corp, D.; Fredrickson, D.; Webster, C.; Christianson, C.C.; Yao, N.P. (Argonne National Lab., Argonne, IL). pp 25-28 of Batteries for electric vehicles: Research, development, testing and evaluation. Warrendale, PA; Society of Automotive Engineers (1983). (CONF-8310223—).

From Society of Automotive Engineers meeting; San Francisco, CA, USA (31 Oct 1983).

Technical Paper 830227.

Lead-acid batteries were tested at the National Battery Test Laboratory at Argonne National Laboratory to determine the effects on the range of an electric vehicle of rest periods introduced during the vehicle use. Rest periods ranging from zero through four hours were chosen to simulate no break, a coffee break, a lunch break, and a work break. Preliminary results suggest that no increase in range can be expected as a result of the rest periods regardless of their length; moreover, it appears that in some cases a slight loss in battery capacity, and therefore in range, may occur as the battery cools during the rest period. Similar testing of the nickel/iron battery system is now underway.

5848 **Design considerations for a Li-Al/FeS battery for an electric van.** Chilenskas, A.A.; Shimotake, H.; Barney, D.L.; Sasaki, T.; Kimura, Y.; Goto, K.; Toda, T. (Argonne National Lab., Argonne, IL). pp 15-18 of Batteries for electric vehicles: Research, development, testing and evaluation. Warrendale, PA; Society of Automotive Engineers (1983). (CONF-8310223—).

From Society of Automotive Engineers meeting; San Francisco, CA, USA (31 Oct 1983).

Technical Paper 830223.

A study on battery-vehicle design interactions was performed jointly by Argonne National Laboratory and Toyota Motor Company. A Toyota Hi-Ace van converted to electric drive was used to model the performance of the vehicle. Power train require-

ments were calculated on the basis of achieving performance equivalent to that of gasoline-engine or diesel-powered vehicles. Vehicle energy requirements were obtained by integrating the power required to complete a SAE J227a/D cycle. A weight analysis for the conversion was completed as well as a preliminary design to locate the batteries within the vehicle without encroaching upon passenger space. The power/energy ratio of the battery was determined as a function of the vehicle range. Specifications for the vehicle and battery for several cases of interest (e.g., gasoline or diesel type acceleration) are given.

5849 **The systems role in the development of electric and hybrid vehicle batteries.** Kurtz, D.W. (EHV Systems R and D Project, Jet Propulsion Lab.). pp 11-14 of Batteries for electric vehicles: Research, development, testing and evaluation. Warrendale, PA; Society of Automotive Engineers (1983). (CONF-8310223—).

From Society of Automotive Engineers meeting; San Francisco, CA, USA (31 Oct 1983).

Technical Paper 830222.

In 1976, following the Arab oil embargo which dramatized this nation's vulnerability to interruptions in the supply of petroleum, Congress passed Public Law 94-413 calling for the development of electric and hybrid vehicles (EHV's). The resulting EHV Program, now administered by the U.S. Department of Energy (DOE), has many components including technical research projects focused exclusively on such areas as the powertrain and energy storage subsystems. The EV is very different from its ICE counterpart. Its available specific power and energy are respectively 5 and 50 times lower--precisely the disadvantages which led to the demise of the EV more than 60 years ago. Because of this handicap, the systems role in design, development and integration is even more critical. JPL* has been assigned the systems R and D responsibility for the DOE Program and as such, has developed prototype proof-of-concept vehicles, provides systems guidance for subsystem research, conducts in-vehicle testing, and performs assessments of current developments and advanced concepts. The purpose of this paper is to examine the basic principles of the JPLI program.

5850 **A least-cost method for prioritizing battery research.** Giese, R.F.; Walsh, W.J. (Argonne National Lab.). pp 1-10 of Batteries for electric vehicles: Research, development, testing and evaluation. Warrendale, PA; Society of Automotive Engineers (1983). (CONF-8310223—).

From Society of Automotive Engineers meeting; San Francisco, CA, USA (31 Oct 1983).

Technical Paper 830221.

A methodology has been developed for identifying the combination of battery characteristics which lead to least-cost electric vehicles. Battery interrelationships include specific power vs. specific energy, peak power vs. specific energy and DOD, cycle life vs. DOD, cost vs. specific energy and peak power, and volumetric and battery size effects. The method is illustrated for the "second car" mission assuming lead/acid batteries. Reductions in life-cycle costs associated with future battery research breakthroughs are estimated using a sensitivity technique. A research prioritization system is described.

29 ENERGY PLANNING AND POLICY

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 5417, 5423, 5485, 5488, 5490, 5491, 5492, 5494, 5495, 5497, 5498, 5855, 5856, 5857, 5859, 5860, 5867, 5869, 5870, 5872, 5873, 5874, 5875, 5876, 5878, 5879, 5880, 5881, 5882, 5883, 5884, 5906, 5907, 5908, 5909, 5914, 5915, 5916, 5917, 5939, 5956, 5968

5851 **(GAO/PART—86-1) Energy Information Administration: Performance evaluation.** (General Accounting Office, Washington, DC (USA)). 1986. 46p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Energy Information Administration's management of the quality of its data and analyses has improved since 1984. However, EIA has not yet established a cycle detailing the scope and frequency of its quality audits, and has models and data collection systems whose documentation did not meet EIA standards or were in need of evaluation or updating. EIA also did not disclose the extent of its involvement with a requesting agency in the establishment of study criteria.

5852 **(GAO/RCED—86-95) Department of Energy: Allegations about the Director of the Office of Minority Economic Impact.** (General Accounting Office, Washington, DC (USA)). 1986. 27p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Rosslee G. Douglas was nominated to be Director of the Office of Minority Economic Impact in March 1981. She requested a reorganization (proposed reduction in force) of her office May 1985. Shortly after she proposed the RIF, allegations were made that the purpose of her proposal was to get rid of two employees whom she did not trust. Other allegations were made against Mrs. Douglas, including allegations that she abused travel, telephone, and Department of Energy motor pool privileges, and that she engaged in illegal contracting practices. GAO found support for some of the allegations regarding the proposed RIF.

5853 **(GAO/RCED—87-25) Reduction-in-force activities: Department of Energy's actions generally comply with requirements.** (General Accounting Office, Washington, DC (USA)). 1987. 25p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Department of Energy reductions in-force and related contract-out actions at the Western Area Power Administration and the Morgantown Energy Technology Center complied with A-76 (Performance of Commercial Activities) requirements. The one exception was that Western officials did not fully comply with the requirement to inventory or schedule for review all potentially affected positions prior to contracting out the work of those positions. As a result all interested parties may not have been informed of planned or potential contracting actions. Because of its RIF and contract actions, Western only partly achieved DOE's stated objectives of increased efficiency, productivity, and cost reductions expected to result from the ceiling reduction. By contracting for most of the work previously done by employees, Western, in effect, reduced its costs by less than 3 full-time equivalent positions instead of the 13 positions involved in the DOE-directed ceiling reduction.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 5372, 5394, 5460, 5469, 5470, 5473, 5486, 5487, 5489, 5495, 5496, 5497, 5515, 5531, 5552, 5559, 5754, 5770, 5772, 5868, 5874, 5920, 5955, 5956, 5957, 5958, 5959, 5969, 5970, 6401, 6414, 6415, 6440, 6441, 6442, 6443, 6444, 6446, 6447, 6448, 6449, 6450, 6451, 6465, 6482, 6489, 6504, 6505, 6534, 6536, 6537, 6556, 6557, 6568, 6571

5854 **(CONF-871075—6) Implementation of the Superfund Amendments and Reauthorization Act.** Sherrod, J.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000947/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Superfund Amendment and Reauthorization Act (SARA) of 1986 is in reality an extension of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 commonly known as Superfund enacted for cleanup of hazardous waste sites and response to releases of hazardous substances. SARA, which was born in the aftermath of the accident in Bhopal, India, and the incident at Institute, West Virginia, creates new directions for community right-to-know reporting and emergency planning and preparedness. Title III of SARA has the specific objectives: increase community knowledge and access to information on presence of hazardous chemicals in their communities, and to prepare states and communities for dealing with potential chemical accidents. The enactment of SARA has significantly impacted industry, employees, and the public. The narrative represents the authors interpretations of the laws as derived from federal and state publications, discussions with EPA representatives, and a variety of independent sources. 5 refs.

5855 **(GAO/AFMD—86-43) Inspectors general: Compliance with professional standards by the EPA Inspector General.** (General Accounting Office, Washington, DC (USA)). 1986. 75p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Statutory offices of inspectors general play an important role in preventing and detecting fraud and abuse, and in promoting economy, efficiency, and effectiveness in federal programs and operations. The Environmental Protection Agency's Office of Inspector General satisfactorily complied with 20 of 23 audit and investigation standards GAO used in assessing the OIG's operations. However, corrective actions are needed to bring the OIG into satisfactory compliance with certain aspects of 3 standards in the areas of evaluating and reporting on internal control systems, gathering evidence to support audit report statements, and developing an annual investigation plan.

5856 **(GAO/AFMD—86-59) Financial audit: Environmental and Energy Conference Study financial statements for 1985 and 1984.** (General Accounting Office, Washington, DC (USA)). 1986. 8p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Environmental and Energy Study Conference is a legislative service organization sponsored by a group of congressional Members who pool their resources to provide its congressional sponsors with information concerning environmental energy issues affecting federal legislation. The organization is exempted from federal income taxes. It had a loss of $56,812 for 1985.

5857 **(GAO/AFMD—86-61) Fish and Wildlife Service: Investigation of alleged accounting violations.** (General Accounting Office, Washington, DC (USA)). 1986. 25p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Allegations have been made that the Fish and Wildlife Service many have understand its FY 1983 financial statements by at least $1.25 million, and that management had concealed an Anti-Deficiency Act violation and did not report it to the President and the Congress as required by the act. The service did submit inaccurate year-end reports because about $420,000 of known obligations were not promptly recorded and because valid FY 1983 obligations totaling over $900,000 were improperly charged to the FY 1984 appropriation. The Service contends that a violation of the act did not occur. In GAO's view, however, the question of whether a violation occurred remains unresolved because the Service did not fully reconcile the account and validate reported obligations for FY 1983.

5858 **(GAO/GGD—87-5) Small Business Act: EPA's disadvantaged business advocate reports to proper management level.** (General Accounting Office, Washington, DC (USA)). 1987. 43p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency's Office of Small and Disadvantaged Business Utilization's Director has been responsible only to, and has reported directly to, the Deputy Administrator, who is the second highest agency official. Therefore, EPA is in compliance with the Small Business Act provisions concerning the OSDBU director's required reporting level.

5859 **(GAO/HRD—87-71BR) Mine safety: Inspector hiring, penalty assessments, and injury reporting.** (General Accounting Office, Washington, DC (USA)). 1987. 9p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Mine Safety and Health Administration has undertaken an intensive inspector hiring program which will result in a force of 1,201, an increase of 90 over MSHA's 1986 ceiling. In calendar year 1986, MSHA assessed $31,388 in penalties against mine operators for failing to report injuries. The consensus of labor organizations and mine associations is that higher fines are needed and that $100 to $500 per violation would make a difference in reporting accuracy. Underreporting occurs mostly for nonserious injuries and fatalities show large differences in what is reported; the indication is that small mines significantly underreport injuries.

5860 **(GAO/IMTEC—86-27) Mining violations: Interior needs management control over automation effort.** (General Accounting Office, Washington, DC (USA)). 1986. 22p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Office of Surface Mining has invested many months of work and over $2 million in its collection system's data base yet the project has been adversely by the system's accuracy and a breakdown of management controls at both the Office and departmental levels. The Office was unable to successfully implement a prior collection system that was experiencing problems and it is highly questionable whether a new data base management system was needed to solve these problems. It is also questionable whether efforts to revise the collection system will result in the development of an effective system for managing the Office's assessment and collection cases. The $2 million approved for the system over a 3-year period was spent in 4 months. An additional $2.4 million was approved to cover the remaining first year costs. Futhermore, a contractor had to be brought in by Interior to monitor the revision effort. An undetermined amount of additional funds will be required to cover costs incurred by the contractor performing the revisions during FY S 1987 and 1988.

5861 **(GAO/RCED—86-221) Surface mining: Difficulties in reclaiming mined lands in Pennsylvania and West Virginia.** (General Accounting Office, Washington, DC (USA)). 1986. 70p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Surface Mining Control and Reclamation Act of 1977 provides uniform, minimum environmental protection standards. It requires mine operators to post a bond to ensure that mined lands will be adequately reclaimed if the operator is not willing or able to do so. GAO found a number of problems in implementing SMCRA requirements. In particular, unreclaimed acreage exists in Pennsylvania and West Virginia, posing risks to the health and safety of the public and the environment. Under the interim program - after enactment of SMCRA but before the states received primary regulatory authority - bond amounts in the two states have not been adequate to reclaim all interim program lands. In addition, the adequacy of the permanent program bonding systems in either state has not been formally assessed. The impact of using reclamation funds for program administration on the ability of the states to reclaim their bond forfeiture lands has not been assessed either.

5862 **(GAO/RCED—87-40) Surface mining: Interior Department and states could improve inspection programs.** (General Accounting Office, Washington, DC (USA)). 1987. 43p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Montana, Ohio, Pennsylvania, and West Virginia are not observing or citing all mining violations, including some with potential to harm the environment. Further, states generally do not accept evidence of violations observed by federal inspectors during oversight inspections which could be used to cite operators. GAO recommends that the Department of the Interior determine the reasons why state inspectors are not citing all violations and, based on this information, work with the states to ensure that all violations of performance standards are cited. GAO also recommends that Interior work with the states to develop criteria for state use of federally observed evidence of violations obtained during oversight inspections in issuing notices of violation which will become part of an operator's violation history.

5863 **(ORNL/TM—10509) Automated sensitivity analysis of CRESS (Commercial and Residential Energy Use and Emissions Simulation System).** Trowbridge, L.D. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001516/JAW.

A sensitivity analysis of CRESS (Argonne National Laboratory's Commercial and Residential Energy Use and Emissions Simulation System) has been carried out using an automated sensitivity analysis tool developed at Oak Ridge National Laboratory (ORNL). CRESS, using several linked computer models, projects US commercial and residential sector contributions to the

emission of five fossil energy-related atmospheric pollutants. These projections are derived from historical and projected economic and demographic parameters and derived energy use projections. Sensitivity analyses of three of the key submodels in CRESS have been carried out with the aid of GRESS ("Gradient Enhanced Software System"), a tool which automates the direct method of sensitivity analysis. Previous reports in this series have discussed the analysis results for individual modules of the CRESS system. This report will summarize the individual analyses and examine the linkage of sensitivities through CRESS as a whole to examine the influence on emission projections of selected input projections and control parameters. 10 refs., 20 figs., 6 tabs.

5864 **(PB—87-229662/XAB) Waste-minimization audit report: case studies of minimization of cyanide waste from electroplating operations.** (Jacobs Engineering Group, Inc., Pasadena, CA (USA)). Aug 1987. 102p. NTIS, PC A06/MF A01.

To promote waste-minimization activities in accordance with the national policy objectives established under the 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act of 1976 (RCRA), the Hazardous Waste Engineering Research Laboratory (HWERL) of the USEPA Office of Research and Development has undertaken a project to develop and test a waste-minimization (WM) audit procedure. As part of the project, a total of 6 WM audits were carried out in four separate facilities. The report presents the results of the on-site WM audits performed at two electroplating facilities that generate cyanide-bearing wastes. The report also describes the WM audit procedure as it has developed from the initial (pre-project) sequence of steps, to the modified (post-project) sequence that reflects the experience gained during this HWERL project.

5865 **(PB—87-232815/XAB) Manual for preventing spills of hazardous substances at fixed facilities.** Unterberg, W.; Melvold, R.W.; Roos, K.S.; Scofield, P.A. (Environmental Monitoring and Services, Inc., Newbury Park, CA (USA)). Aug 1987. 198p. NTIS, PC A09/MF A01.

The purpose of the manual is to provide guidance to prevent spills of hazardous substances in fixed facilities that produce substances from raw or starter materials, store the substances, or transfer the substances to and from transportation terminals. The emphasis is on smaller-sized chemical manufacturing facilities. The manual consists of seven sections and an Appendix: (1) Introduction: (2) Manual of practice; (3) Hazardous substances and their characteristics; (4) Fixed facilities; (5) Facility spill prevention practices; (6) Preventive engineering practices; and (7) Bibliography. Section 1 contains the purpose and an overview of the manual. Section 2, the manual proper, deals with the preparation of a Facility Spill Prevention Master Plan and makes use of Sections 3, 4, 5, and 6. Section 3 contains a listing of all hazardous substances under consideration, with their physical behavior on release to air, water and ground, and their specific hazards. Section 4 lists the fixed facility equipment elements that would interact with hazardous substances. Section 5 lists the various facility spill prevention practices, including organization, risk identification, material compatibility, preventive maintenance, good housekeeping, security and training. Section 6 details the preventive engineering practices such as monitoring and secondary containment of storage vessels, fire protection systems, alarm systems, valving and venting, drainage control, waste treatment, etc. Section 7 lists the sources used in preparing the manual. The appendix contains descriptions of fixed facility chemical processing equipment components, from which a checklist of equipment items interacting with hazardous substances can be derived for use in preparing a Spill Prevention Plan.

5866 **Spatial and temporal variability of biospheric and geospheric processes: Research needed to determine interactions with global environmental change.** Risser, P.G. (comp.). Paris, France; International Council of Scientific Unions (1986). 55p. (CONF-8510284—Summ.). ICSU Press, 51 Boulevard de Montmorency, 75016 Paris, France. Order Number DE88001382/JAW. Contract FG05-85ER60371.

From Workshop on spatial and temporal variability of biospheric and geospheric processes: research needed to determine interactions with global environmental change; St. Petersburg, FL, USA (28 Oct 1985).

The workshop explored existing methods for dealing with spatial and temporal heterogeneity of biospheric and geospheric processes, suggested new approaches to the scaling issue, identified important research projects of international scope and importance, and further developed the plans for the Global Change or International Geosphere-Biosphere Program. This document is a report of the workshop findings.

2904 Natural Resources

REFER ALSO TO CITATION(S) 5864

5867 **(GAO/AFMD—86-42) Timber sale accounting: Analysis of Forest Service's Proposed Timber Program Information Reporting System.** (General Accounting Office, Washington, DC (USA)). 1986. 25p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Forest Service's proposed Timber Sale Program Information Reporting System will not be fully responsive to a complete cost accounting system that will compare actual costs and benefits. GAO believes the the Forest Service has placed emphasis on formatting a new series of external reports that will be of only limited use in managing the timber sale program. The program needs better management and better use of the existing accounting system.

5868 **(GAO/RCED—86-157) Mineral resources: Forest Service has a limited but influential role.** (General Accounting Office, Washington, DC (USA)). 1986. 39p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Over $1 billion worth of coal, oil, and natural gas were produced from the Department of Agriculture's Forest Service lands in FY 1984. Generally, the Service's role in federal minerals management is to protect surface resources while mineral exploration and development takes place on its lands. It has been criticized by one environmental group for not being sensitive to environmental concerns and by some mineral industry groups for poorly managing mineral development. GAO found in the cases it reviewed that the Forest Service's minerals management decisions were based on professional analysis that balanced the competing demands of surface protection with mineral development.

5869 **(GAO/RCED—86-159FS) Parks and recreation: Obligations and outlays from the Land and Water Conservation Fund.** (General Accounting Office, Washington, DC (USA)). 1986. 77p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Land and Water Conservation Fund program serves as a funding source for federal acquisition of public park and recreation lands and for grants-in-aid to state and local governments for the planning, acquisition, and development of outdoor recreation areas. It is currently authorized to receive $900 million annually from Outer Continental Shelf mineral receipts, federal surplus property sales, motorboat fuel taxes, and recreation fees. This report presents federal agencies obligations and outlays from the fund for FYS 1976 through 1985. It also shows the obligations and outlays for matching grants to states for FYS 1976 through 1985.

5870 **(GAO/RCED—86-187) Biotechnology: Analysis of federally funded research.** (General Accounting Office, Washington, DC (USA)). 1986. 38p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

This review verifies and analyzes data on federal support for biotechnology research in FY 1985 in the Department of Agriculture, the Environmental Protection Agency, the Food and Drug Administration, the National Institutes of Health, and the National Science Foundation. Dollars obligated and the number of projects funded were reported for agencywide activity for the conduct of research and development, biotechnology-related research, and biotechnology risk assessment.

5871 **(GAO/RCED—86-203FS) Rangeland management: Profiles of Federal grazing program permittees.** (General Accounting Office, Washington, DC (USA)). 1986. 23p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Grazing privileges have been assigned to approximately 20,000 permittees who annually graze about 4.6 million cattle, sheep, and horses on public rangelands managed by the Bureau of Land Management. These permittees include individual ranchers as well as corporations, large and small operators, and local and out-of-state operators. GAO's profile projections show that about 76 percent of the permittees are individuals, 11 percent are corporations, and 8 percent are partnerships. About 91 percent of the permittees own base property, while 8 percent lease it. Over 80 percent of both permittees and owners of base property are local residents and about 95 percent of the permits are held by residents either within 100 miles of the base property or within the same state.

5872 **(GAO/RCED—86-217) Public lands: Interior should recover the costs of recording mining claims.** (General Accounting Office, Washington, DC (USA)). 1986. 8p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

GAO believes that direct and indirect costs associated with recording mining claims can be recovered. Compliance with the Department of the Interior's cost recovery policy and guidelines could have increased fee collections by up to $1.7 million in FY 1984. Comparable savings could be realized in the future if the Bureau of Land Management follows Interior's cost recovery guidelines for determining recoverable costs associated with recording mining claims.

5873 **(GAO/RCED—86-232FS) Parks and recreation: Construction contract at Jean Lafitte National Historical Park.** (General Accounting Office, Washington, DC (USA)). 1986. 17p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Construction of a visitor-user facility at the Jean Lafitte National Historical Park in Jefferson Parish, Louisiana experienced performance problems concerning delays in completing the facility, increases in the contract cost due to design changes, and an unusual number of problems not indicated on contractor claims and modifications. This report assesses whether the problems have been corrected and whether all the standards for the work would be met when the facility was completed. It also identifies procedural and/or personnel changes that should be made to avoid similar contract delays in the future.

5874 **(GAO/RCED—87-24BR) Parks and recreation: Concerns raised about National Park Service actions at Delaware Water Gap.** (General Accounting Office, Washington, DC (USA)). 1987. 22p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The National Park Service followed Department of the Interior regulations, policies, and guidelines in soliciting and reviewing proposals and determining that Shawnee Inn was the successful bidder in the lease of the Copper Mine Inn at the Delaware Water Gap National Recreation Area located in Pennsylvania and New Jersey. The National Park Service's decision to close the commercial campground operated by Mr. Donald Von Hagan is consistent with the general management planning process. Mr. Von Hagan's rent represents the fair market rental rate established by an independent appraiser.

5875 **(GAO/RCED—87-28FS) Land management: Forest planning costs at the Boise and Clearwater National Forests in Idaho.** (General Accounting Office, Washington, DC (USA)). 1987. 15p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Boise National Forest spent $82.2 million during the past five fiscal years. Of that estimate, the forest used $2.5 million, or about 3 percent, in developing its forest plan. In comparison, of the $93.7 million spent by the Clearwater National Forest during the same period, the forest used about $2.1 million, or about 2.3 percent, in developing its forest plan. Breakdowns show that most forest planning costs were attributable to the National Forest Management Act of 1976 and the National Environmental Policy Act of 1969. Boise and Clearwater staffs estimated that 75 percent and 86 percent, respectively, of its planning costs were attributable to these two acts.

5876 **(GAO/RCED—87-41FS) Federal land acquisition: An update on Federal agencies' progress under the Alaska Lands Act.** (General Accounting Office, Washington, DC (USA)). 1987. 50p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

GAO found eight sections of the Alaska National Interest Lands Conservation Act in which actions were to be completed by December 2, 1985. The deadline date was not met on any of these actions. Two sections - on developing management plans for the Steese Conservation and White Mountain Recreation Areas - ran over the deadline date by a few months. Another two - preparing a report to Congress on the Arctic Refuge and preparing a report to the Congress on the Stikine River region - had report drafts in the process of being issued on the deadline date. Because the remaining four sections missed the deadline date, management plans and studies for refuges, parks, wilderness, and wild and scenic river areas are not available for federal agency use in managing these areas.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 5492, 5552, 5573, 5683, 5758, 5848, 5849, 5870, 5875, 5878, 5914, 5949

5877 **(CONF-871229—1) Technology transfer and commercialization of advanced ceramics through consortia.** Craig, D.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002300/JAW.

From American Society of Mechanical Engineers meeting; Washington, DC, USA (15 Dec 1987).

Market studies conducted over the last several years project the worldwide sales of advanced ceramics to double every five to seven years. However, realizing these projections requires that cost-effective, reliable processing techniques be developed which yield components with levels of purity, perfection, and scale far beyond that of traditional ceramics. The lack of applied R and D in the area of processing and manufacturing sciences has created a technology gap that is impeding the commercialization of advanced ceramics and threatening US industries' competitive position in the international arena. An industrially sponsored and managed consortium, the Ceramics Advanced Manufacturing Development and Engineering Center (CAMDEC), has been proposed as a means of marshalling the resources necessary to address this gap in the path to commercialization and of providing an innovative mechanism for technology transfer. The concept and status of the Center are discussed. 4 figs.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 5412, 5415, 5416, 5460, 5469, 5470, 5471, 5473, 5485, 5486, 5487, 5488, 5489, 5490, 5491, 5492, 5494, 5495, 5496, 5497, 5498, 5515, 5531, 5541, 5552, 5559, 5562, 5710, 5770, 5854, 6399, 6400, 6534, 6537, 6568

5878 **(GAO/RCED—87-26) Energy R and D: Changes in Federal funding criteria and industry response.** (General Accounting Office, Washington, DC (USA)). 1987. 69p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Energy R and D policy has been reoriented to emphasize long-term, high-risk, ower payoff technologies in their early stages of development. The civilian nuclear reactor R and D budget has been an exception with Department of Energy support for these technologies insulating them from major reductions in the early 1980's. Civilian reactor programs sustained substantial reductions beginning in FY 1984, but these reductions were based on other considerations, such as safety issues, as well as the long-term, high-risk, high-payoff criteria. There is little indicate that the private

sector has compensated for cutbacks in DOE R and D. Among the reasons are (1) market factors have reduced the potential profitability of technology development and (2) many activities curtailed by DOE are viewed as too risky to finance without government support. This has contributed to delays in technology development and, in some cases, to an erosion of American technological leadership.

5879 **(GAO/RCED—87-43BR) TVA nuclear power: Management of the nuclear program through personal services contracts.** (General Accounting Office, Washington, DC (USA)). 1987. 27p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Mr. Steven White, a retired admiral, is serving as manager of the TVA Office of Nuclear Power. GAO previously concluded that Mr. White's retention under contractual arrangements constituted the improper use of a personal services contract and represented a circumvention of the statutory ceiling on salary payments to TVA employees. This report finds that Mr. White's rate of pay is within the range of the salaries paid by a sample of nonfederal utilities to their top executives and is over two and a half times the average salary paid to executives who hold positions which appear to have responsibility for managing the utilities' power or nuclear power operations. GAO also found that (1) TVA's Office of Nuclear Power has employed an additional 25 persons since 1986 under arrangements similar to the employing arrangements of Mr. White and (2) TVA's Nuclear Safety Review staff no longer reports directly to the TVA Board of Directors and General Manager. It has relocated from Knoxville, Tennessee to Chattanooga, Tennessee.

5880 **(SSI—86-27) Attitudes towards emergency plans, information and tasks. Investigation of a number of professions incorporated in the emergency organization of the province of Halland.** Hultaaker, Oe. (National Inst. of Radiation Protection, Stockholm (Sweden)). Nov 1986. 57p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750372/JAW.

The staff composed of policemen, firemen, home-guards and coast-guards having emergency service at the Ringhals nuclear power plant have been interviewed as to their viewpoints. They have a similar attitude to nuclear power as the general public which is varying. They accept, however, the actual risk evaluation to a large extent. There are also opponents of nuclear power who are difficult to motivate about the training for emergency service. (G.B.).

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 5950, 5974

2910 Conservation

REFER ALSO TO CITATION(S) 5869, 5876, 5961, 5962, 5963

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 5710, 5916

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 5471, 5492, 5494, 5496, 5515, 5531, 5541, 5562, 5849, 5854, 5855, 5856, 5857, 5858, 5861, 5862, 5867, 5871, 5872, 5874, 5876, 5878, 5906, 5914, 5917, 5918, 5957, 5958, 5969, 5970, 6537, 6568

5881 **(GAO/AFMD—87-16FS) Financial management: Information on expenditures by Interior's Office of the Solicitor.** (General Accounting Office, Washington, DC (USA)). 1987. 18p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

This fact sheet concentrates on the number of staff assigned to and the amount of funds spent in support of Interior's Office of Surface Mining. It highlights the Solicitor's FY 1986 budget request, as adjusted to reflect actual appropriations, and Gramm-Rudman-Hollings reductions by programs and activities; obligations incurred by the Solicitor during FY 1986 and 1985 as compared with the budget request; detailed accounting information on the obligations for programs and activities by the general expense categories of personnel, other, and overhead; the Solicitor's actions concerning the relevant budget and accounting statutes and reprogramming requirements in his disposition of appropriated funds; and the number of individuals assigned to Office of Surface Mining Cases.

5882 **(GAO/GGD—87-3) Small Business Act: Interior's disadvantaged business advocate reports to proper management level.** (General Accounting Office, Washington, DC (USA)). 1987. 2p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of the Interior's Office of Small and Disadvantaged Business Utilization's Director has been responsible only to, and has reported directly to, the Under Secretary, who is the second highest Department official. Therefore, the Department is in compliance with the Small business Act provisions concerning the OSDBU Director's required reporting level.

5883 **(GAO/GGD—87-69) Small Business Act: Energy's disadvantaged business advocate not reporting to proper management level.** (General Accounting Office, Washington, DC (USA)). 1987. 7p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Small Business Act requires each federal agency with procurement powers to establish an Office of Small and Disadvantaged Business Utilization. The agency head shall appoint a Director for this office who shall be responsible only to and report directly to the agency head or deputy. Because the Director, OSDBU, is not reporting directly to and is not responsible only to the Secretary or Deputy Secretary of Energy, GAO concludes that his reporting level is not in compliance with the Small Business Act.

5884 **(GAO/RCED—86-134) U.S. grain exports: Concerns about quality.** (General Accounting Office, Washington, DC (USA)). 1986. 50p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Complaints are on the rise from wheat producers who see grain leaving their farms in good condition, but who then suspect that export elevators add dust and other material to the grain to boost the elevators' profits. Some believe that this is a reason why an increasing number of foreign purchasers of U.S. grain have been expressing dissatisfication with the quality of the grain they have received. Fear has also been expressed that these purchasers will turn to other countries to satisfy their grain needs, if they have not already done so. GAO made a number of recommendations in the past dealing with the quality of U.S. grain shipped overseas that if implemented would have resulted in inspection certificates that more accurately reflected the actual quality of the grain, provided end-users with better information on certain quality factors, and assured greater uniformity in grain quality within a shipment. The recommendations have not been implemented.

5885 **(NEI-SE—6) Energy ahead '85. Vattenfall annual R and D Report.** Hultin, S.A.; Brunn, B.; Kvist, B.; Eklund, S.A.; Jonsson, H.; Smitterberg, B. (ed.). (Swedish State Power Board, Vaellingby). 1985. 66p. NTIS (US Sales Only), PC A04. Order Number DE88750396/JAW.

This report presents the Swedish State Power Board's (Vattenfalls) research and development activities in a popular way. The research work covers many different fields within and in connection to the energy production area. (BoK).

5886 (STEV—1986-3, pp vp) **Background paper: Soviet energy policy.** Dellenbrant. J.Aa. (Uppsala Univ. Sweden. Dept. of Soviet and East European Studies). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87752397/JAW. (CONF-8506356—).

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

Soviet Energy.; 95 p. .

In this paper, some fundamental elements of the Soviet energy policy are analyzed. The specific areas included in the paper are, among others, the physical conditions of Soviet energy policy, the role of energy in the Soviet policy toward the Comecon countries and toward the Western markets. Also, the role of energy in Soviet foreign policy will be commented upon as well as the problem of dependence on Soviet energy from the West's point of view. The main focus of the paper is on the Soviet Union although some comparisons will be made with the European Comecon countries, i. e. the GDR, Poland, the Cssr, Hungary, Romania and Bulgaria. Furthermore, the main focus will be on problems concerning energy production from fossile fuel and hydrocarbons, but water power and nuclear power will also be considered. The paper is devoted to the policy aspects of Soviet energy, rather than to technical problems.

5887 (STEV—1986-12) **Municipal energy planning.** (Statens Energiverk, Stockholm (Sweden)). Nov 1986. 97p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750412/JAW.

According to a recent law all swedish local communities must have a local energy plan by January 1, 1986. The National Energy Administration has followed the work with the plans to learn how the work has been performed, what questions have been considered important, how the energy plans have been published etc. The impervious from the follow-up are presented in this report. A historic background to the energy planning situation of the lcal communities is also given. (L.E.).

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 5372, 5394, 5394, 5399, 5403, 5403, 5412, 5413, 5414, 5415, 5416, 5418, 5423, 5868, 5868, 5868

5888 (EPRI-P—5417, pp 2.1-2.8) **New volatility: oil and geopolitics.** Bupp, I.C. (Cambridge Energy Research Associates, MA). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The geopolitics of oil supply in the US is discussed. The volatility in world oil prices and the outlook for future oil prices are discussed both within OPEC and between open and non-open countries. It is concluded that the outlook for oil prices is that there is no obvious recipe for oil price stability in the next few years. It is expected that continued volatility within a range of about $12-14/barrel at one end to $20-22/barrel at the other end will be experienced.

5889 (EPRI-P—5417, pp 3.1-3.13) **New scenarios for economic growth.** Newland, E.V. (Cambridge Energy Research Associates, MA). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The uncertainties that face the utility industry at all levels: national, state and local are discussed. The first building block to deal with these uncertainties is addressed. If one is interest only in long-term fuel oil prices for example, this study is not going to be directly relevant to that task. But, it is an essential building block, because without some structured views as to how the future may develop, one will be working in a vacuum, particularly if one is dealing with other decision makers. The large part of the scenario process is structuring the mental map so that one can have meaningful communication before making decisions. Some new scenarios for economic growth are presented.

5890 (EPRI-P—5417, pp 4.1-4.5) **Remarks by the session chairman [on the choice of boiler fuels for electric utilities].** Alley, W.M. (Arkansas Power & Light Co., Little Rock). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Past decisions on the choice of boiler fuels for generating electricity have been made by utilities without reference to the fuel choices open to their customers for electric power. This period of choosing fuels independently of the customer options is now ending and will lead to much more complex fuel planning. The traditional method of fuel selection was to buy fuel, often under long-term contracts that were linked to the anticipated life of the power plant. These fuels were then converted into electricity, transported and sold. Rates were established to reflect the costs of production and delivery. In almost all cases, these rates were below the cost to a customer for self-generation of electricity. Utility customers, for their part, bought fuel to meet specific thermal requirements. Their fuel costs directly affected overall profitability. On the other hand, utilities did not have their earnings impacted by rising fuel costs because rate adjustments were allowed.

5891 (EPRI-P—5417, pp 5.1-5.15) **Fuel options and new generating technologies.** Ellert, F.J.; Simons, N.W. (General Electric Co., Schenectady, NY). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Over the last ten years, electric utilities in the US have experienced a great deal of turmoil. By now, with their major construction programs behind them, many utilities are entering a transitional period where little new generating capacity is needed. However, this is just the time for the utilities to be developing strategic plans as to how they can serve their customers' needs and meet the challenges in the 1990s and beyond. A recent forecast of required US generation resources suggested that about 100 GW of uncommitted resources must by added by the year 2000. The utilities have many options for meeting these future needs. Among the most viable are plant life extension, repowering, coal-stream, combined cycle, IGCC and IG-STIG. Fuel prices and availability, as well as plant costs, will strongly influence which options are selected. The economics of these alternatives are discussed along with analyses of the sensitivity to fuel prices and plant costs. In addition, a forecast is presented of the potential mix of the future generation additions up to the year 2000.

5892 (EPRI-P—5417, pp 6.1-6.16) **Using fuel price scenarios.** Vetter, J.R. (Florida Power & Light Co., Miami). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Florida Power & Light Company's (FPL) overall fuel and generation planning process is described. Specifically, how scenarios were used for both fuel price forecasting and generation planning, is explained. Florida Power & Light Company is the nation's fifth largest investor-owned electric company based on customers served. Its service territory of about 28 thousand square miles runs down the entire east cost of Florida and includes the southern one-third of the state. FPL serves approximately 5.5 million people, with forecasted population growth of 2% per year over the next ten years.

5893 (EPRI-P—5417, pp 7.1-7.7) **Fuel wars.** Niggli, M.R. (San Diego Gas & Electric Co., CA). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The year 1986 proved to be one of the most volatile periods ever for the electric utility industry as competition for fuel supply to power plant boilers reached a maddening pace. This volatility was a result of numerous factors, primarily driven by the collapse of residual fuel oil prices during the spring of 1986. Some of the actions taken by San Diego Gas & Electric Company (SDG&E) in response to the quickly changing fuel market are outlined, as well as the preparatory actions taken by SDG&E to permit the utility to take maximum advantage of this fluctuating situation.

5894 (EPRI-P—5417, pp 8.1-8.15) **Industry wide planning and operating responses to low oil prices.** Hughes, W.R. (Charles River Associates, Inc., Boston, MA). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

From the 1973-1974 crisis and the 1979 price increase through the spring of 1983, electric utilities operated and planned in an environment of high oil prices. Long-range price forecasts were

generally for further price increases. In that context, economical operation and intelligent planning involved designing away from oil. Hence, electric utility oil-fired generation declined during the 1975 to 1985 period. In this context, how electric utilities should respond to this changed environment is discussed. The actual responses of utilities during 1986, both in operating decisions and planning for future generation, and inquires into the future adjustments electric utilities are likely to make in the event of further reductions in oil prices or continuation of present price levels and expectations are addressed.

5895 (EPRI-P—5417, pp 9.1-9.19) **Use of consensus forecast evaluations in prudence inquiries.** Oliva, L.M. (Principal, Putnam, Hayes & Bartlett, Inc., San Francisco, CA). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The recent decline in oil and gas prices exacerbates an already serious problem - how to allocate the economic losses of utilities that implemented long-range expansion plans based on very different expectations of fuel markets. Public utility commission attempts to hold utility companies responsible for investments that went sour include detailed inquiries into the prudence of utility actions and judgments. Fuel forecasts are key assumptions in the economic evaluation of resource planning alternatives, and fuel supply planning has been and will continue to be an area of scrutiny by outside reviewers. A four-fold approach to describing why the consensus approach to fuel forecasting is important in today's regulatory arena is described. Not only is it defensible, a consensus approach is a relatively easy and inexpensive way to satisfy commission inquiries into fuel forecast reasonableness. Forecast comparisons are being used by commission staffs and interveners in regulatory proceedings. To fulfill this theme, the regulatory context now imposed upon utilities, with emphasis on the prudence standard and its application is described. A case example is discussed which includes the application and misapplication of consensus theory and guidelines for a self-imposed prudence audit are described that reflect requirements of the trend toward commission micro-oversight. Finally, an EPRI program that offers a research tool to assist utilities in building a data base for consensus forecasting analysis is described.

5896 (EPRI-P—5417, pp 10.1-10.11) **Exploration trends.** Fitch, F.W. III. (Credo Petroleum Corp., Denver, CO). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The petroleum industry is currently undergoing major changes in philosophy, direction, and emphasis due to the precipitous drop in oil prices. From a November 1985 price of $28 per barrel, there has been a 50% decline to the current price level. The corporate responses to this change have varied but bear a common direction. Sharp reduction in exploration expenditures have been reflected in reduced staff size and plummeting drilling activity. The effect on the current environment for exploration and reserve replacement has been striking. With few exceptions, new higher-risk exploratory projects have been canceled or deferred. The effects for the purchaser in both the long and short term will be significant. Sharp fluctuations in wellhead prices can be expected, but cannot be predicted with any certainty. This study attempts to answer two key questions. First, what is the current environment for US exploration and production, and second, how are drilling prospects being selected and financed?

5897 (EPRI-P—5417, pp 11.1-11.11) **Acquisition costs for oil and gas.** Ross, D. III. (Sterling Group, Houston, TX). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The cost of purchased gas is an important consideration in understanding the economics and competitive position of most electric public utilities. In recent years, the cost of gas has fallen drastically. Current concern focuses on how long these prices will last and how extensive increases will be when they come. As I talk to people, there is a consensus that current gas prices in the $1.50/MCF range are clearly a short-term phenomena and that they will rise in the future. The timing and extent of this rise is the subject of much research, and large differences of opinion exist. The problem is considered from a basic economic viewpoint. The energy resource is owned by a chain of owners beginning with the mineral rights owner and moving on through the finding oil company, the holding company, the transportation company, the utility company and finally ending with the consumer. The finding company often sells its oil to a second, third, or fourth company each of which holds the resource in hope of price appreciation before the oil or gas is actually produced. Having been held for a period of time, it's transported, usually by a third entity, and sold to a utility, who in turn sells it to the ultimate customer either in the form of gas or electricity. The cost to obtain oil and gas supplies is discussed.

5898 (EPRI-P—5417, pp 12.1-12.4) **Gas market risk: perspective of a large gas consuming utility.** Brackeen, L.G. (Houston Lighting and Power Co., TX). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Currently, over 38% of the electricity sold by Houston Lighting & Power Company is generated from natural gas. Natural gas consumption has decreased dramatically since the peak year of 1981 when an annual average of about 1300 million cubic feet per day was used compared to 1986 consumption of 750 million cubic feet per day. This resulted from a concerted program of adding alternate fuel capability plus a large quantity of cogeneration capacity built in the authors service area. The reduction of gas dependence is deceptive since the cogeneration is nearly all gas fired. Including cogeneration, the total dependence on the natural gas market is still nearly 65%, the equivalent of 1200 million cubic feet per day. The position as one of the largest gas consumers in the nation located at the heart of the natural gas pipeline system gives insight into the risks inherent in the gas market which may be of interest to other utilities. Six years ago, a discussion of gas market risk would have evoked concern only about the risk of curtailment and long-term security of supply. The focus shifted about three years ago to the risk that high gas prices might be disallowed by the regulatory authority. This gas market risk is discussed.

5899 (EPRI-P—5417, pp 13.1-13.15) **What you've always wanted to know about residual fuel oil quality.** Culberson, S.F. (Pace Consultants, Inc., Houston, TX). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The quality of residual fuel oil, or resid, available to electric utilities has deteriorated. The quality change has caused operating problems to the extent that several utilities are asking whether the quality has now stabilized. What action should be taken to eliminate the problems or to compensate? What are the relative economics of using lower quality residual fuel versus insisting on better quality from refiners and marketers? This study considers: (1) historic quality changes; (2) future resid quality, and (3) what electric utilities should do in response to quality changes.

5900 (EPRI-P—5417, pp 17.1-17.19) **Fitting low-sulfur coal into the compliance equation.** Platt, J. Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Recent Electric Power Research Institute (EPRI) studies examine price movements of different quality coals, low-sulfur coal availability and utility responses to proposed acid rain legislation. Utility strategies to reduce SO_2 emissions are analyzed as a choice between two major options, retrofit scrubbing or switching to lower sulfur coal. The balance between these options define the compliance equation. Building from site-specific estimates of transportation, scrubbing and other engineering costs, and evaluating these at a utility system level, unique insights on coal markets and utility compliance decisions are obtained. Diversity characterizes utility responses under all scenarios. Scrubbers account for at least one-third of total SO_2 reductions achieved under a 5 million ton bill and as much as three-quarters under a 10 million ton bill. Demand for low-sulfur coal is very sensitive to its price. Scrubbers buffer the rise of low-sulfur coal prices and mitigate the losses in Midwest high-sulfur coal production. Western coal receives a negligible

boost. Price movements of low (1.0% S) and very low-sulfur (0.7% S) coal move hand-in-hand under 5 and 8 million ton scenarios, whereas a substantial premium occurs for very low-sulfur coal under a 10 million tons scenario since low-sulfur coal no longer provides the reductions in emissions that are required. Information about low-sulfur coal supplies is encouraging over the intermediate term but inadequate for industry decisions and policy-making beyond that.

5901 (EPRI-P—5417, pp 18.1-18.17) **Price premiums for low-sulfur coal in the east.** Price, J.P.; Bissell, P.E. (Resource Dynamics Corp., Vienna, VA). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Current proposal for federal acid rain legislation call for reductions in electric utility sulfur dioxide emissions in the range of 8 to 12 million tons per year. A controversial issue with these proposal is whether to allow utilities to choose the method of emission reduction (including switching the low-sulfur coal) or the force utilities to apply technological means of compliance. Increased use of low-sulfur eastern bituminous coal plays a major role in achieving reductions in sulfur-dioxide emissions under proposals which allow utilities to choose the most economical compliance strategy. The effects of such increases in demand on price premiums for eastern low-sulfur coal are subject of major disagreements. Some industry analysts contend that greatly increased demand will cause large new price premiums. Others disagree, asserting that large new price premiums are unlikely. Coal markets in the East use the broadest diversity of coal types, have the longest history of coal use, and are the central focus of acid rain concerns. By understanding how premiums occurred in these markets and by identifying those causes which might continue or end, a framework for analyzing the potential for future premiums can be developed. Methods for analyzing the potential for future coal price premiums are discussed.

5902 (EPRI-P—5417, pp 19.1-19.13) **Outlook for productivity in the coal industry.** Suboleski, S.C. (A. T. Massey Coal Co., Richmond, VA). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Over the past 25 years or so the coal industry has gone from depression to euphoria and back to what is currently one of the deepest depressions ever experienced by the industry. From the post-war period until the early 1960s the industry generally declined as traditional markets disappeared. The electric generating market expanded sufficiently to reverse the industry's fortunes in the sixties; growth was steady up to the 1973 to 1975 period when a short-lived boom unleashed the dreams of many traditionally non-coal mining companies. Although, in real terms, this was the industry's peak profit period, the continued relatively high prices coupled with the predictions from government studies and the World Coal Study kept expectations growing through 1982 when, following the mine workers' strike, prices broke and have been sliding downward ever since. Productivity similarly experienced wide swings: growing steadily through 1969, then dropping almost in half (in deep mines) over the next decade, only to reverse and reach approximately the all-time high level again this year. The causes of the past swings in productivity are reviewed and, in light of these factors, the likelihood of another change in direction in the next five to ten years is examined, in particular, the probable impact which a shift to lower sulfur coal may have on productivity and prices since this disruption is one which has some probability of occurrence is discussed.

5903 (EPRI-P—5417, pp 20.1-20.11) **Coal market data applications in the electric utility industry.** McMahan, R.L. (Data Resource International, Inc., Denver, CO). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

Over the past few years there has been a structural change in fuel buying practices. In particular, the coal market is in a sustained period of oversupply resulting in ongoing market adjustments. Three key elements in understanding the market and in knowing how best to anticipate shifts are discussed. First, one must understand how and by whom the market is made. All three links in the coal chain are important here - buyers, carriers, and producers. It can be argued that coal markets are made by the 10 most influential buyers, an ever-consolidating coal transportation industry and the 25 largest coal producers. Second, one must monitor those elements that are particular to one's own environment. Such things as specific fuel needs, dispatch capabilities, and regulatory constraints create local markets that act as small eddies deflecting stronger currents in the market. And third, one must have the managerial and technical means to play the market. As contract duration continues to shrink and spot transactions grow in number, the pace of the market will quicken. Both large and small companies will have to develop new methods for staying in and abreast of the market.

5904 **(GAO/RCED—86-69) Mineral revenues: Delays in processing and disbursing onshore oil and gas bid revenues.** (General Accounting Office, Washington, DC (USA)). 1986. 33p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of the Interior's procedures and guidelines for depositing and processing offshore bid revenues are adequate but procedures for depositing, processing, and disbursing onshore bid revenues could be more timely. More timely receipt and deposit of onshore bid revenues would decrease the need for the Treasury to borrow money and incur interest. Interior could also save Treasury interest costs by streamlining its procedures for notifying wining bidders of bid acceptance and for requiring final payment from onshore bidders.

5905 **(GAO/RCED—86-78BR) Offshore oil and gas: Views on Interior's comments to GAO reports on leasing offshore lands.** (General Accounting Office, Washington, DC (USA)). 1986. 30p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

This report focuses on the Department of the Interior's criticism of the methodology GAO used to estimate the reduction in bid revenues caused by the shift to area-wide leasing; Interior's views that faster receipt of total offshore revenues to the government would more than offset GAO's estimated reduction in bid revenues; the status of Interior's Gulf of Mexico regional mapping program; the adequacy of Interior's data to evaluate tracts for ensuring receipt of fair market value; Interior's bid-acceptance procedures and criteria used to accept bids; Interior's acquisition of geological and geophysical data; and Interior's noncompliance with an annual reporting requirement of the Outer Continental Shelf Lands Act.

5906 **(GAO/RCED—86-153) Energy regulation: DOE should ensure oil industry retains records to resolve violations.** (General Accounting Office, Washington, DC (USA)). 1986. 35p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of Energy estimates that, as of April 1986, about $4 billion of oil firms' alleged violations of crude oil and petroleum product price and allocation controls remain unresolved. In resolving these violations, Energy uses the oil firms' records but in January 1985, Energy changed the rules associated with the firms' need to retain these records because it believed it would not be able to enforce its recordkeeping requirements beyond January 1985 unless it issued an amended rule by that date. The cut-off date proved to be unrealistic and Energy sent letters to 841 firms notifying them that their records were to be retained until further notice for enforcement proceedings. Because Energy did not have current addresses for all the firms, 75 of the 841 did not receive their letters and might have disposed of their records, even though Energy could need them to effectively conclude its enforcement actions.

5907 **(GAO/RCED—86-165BR) Energy prices: Gasoline price increases in early 1985 interrupted previous trend.** (General Accounting Office, Washington, DC (USA)). 1986. 62p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

In 1985, wholesale gasoline prices did not continue the downward trend begun in 1981 despite a continuing decline in

crude oil prices. As a result, the spread between these two prices increased in 1985, but only to a level approximating what existed in 1981 and 1982. The Federal Trade Commission investigated two proposed mergers between Texaco, Inc., with Getty Oil Company and Chevron Corporation with Gulf Corporation that had the potential for anticompetitive effects. Using a regression analysis, GAO suggests that increases in concentration at the state level have a positive association with gasoline prices. Because the required divestitures eliminated the increases in concentration exceeding the merger guidelines, GAO believes the two mergers would have had only a small effect on prices.

5908 **(GAO/RCED—87-75FS) Naval petroleum reserves: Oil sales procedures and prices at Elk Hills, April through December 1986.** (General Accounting Office, Washington, DC (USA)). 1987. 9p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Elk Hills Naval Petroleum Reserve is located near Bakersfield, California and ranks seventh among domestic producing oil fields. In Feb. 1986 the Department of Energy awarded contracts to 16 companies for the sale of about 82,000 barrels per day of NPR crude oil between April and September 1986. These companies bid a record high average discount of $4.49 from DOE's base price. The discounts ranged from $0.87 to $6.98 per barrel. These contracts resulted in DOE selling Elk Hills oil as low as $3.91 per barrel. Energy stated that the process for selling from NPR had gotten out of step with today's marketplace. Doe subsequently revised its sales procedures which requires bidders to submit a specific price for the oil rather than a discount to a base price. DOE also initiated other efforts designed to avoid future NPR oil sales at less than fair market value.

5909 **The impact of oil import quotas on oil imports and prices in the international oil market.** Horwich, G.; Miller, B.A. (Office of Economic Analysis, U.S. Dept. of Energy). pp 283-296 of Energy markets in the longer-term: Planning under uncertainty. Kydes, A.S.; Geraghty, D.M. New York, NY; Elsevier Science Pub. Co. Inc. (1985). (CONF-840851—).

From 2. IMACS symposium on energy modeling and simulation; Upton, NY, USA (26 Aug 1984).

Quotas that reduce the level of oil imports are imposed in a model simulating the world oil market. An intermediate level of supply and demand price elasticities is assumed along with the existence of a core of oligopolistic producers. The simulated world price of oil is highly responsive to the import restraints, rising significantly even for relatively modest quota-mandated import reductions and small sizes of the oligopolistic core. As the size of the import reduction increases, however, a point is reached at which the impact on the world price is downward. The results of the simulation cast serious doubt on the desirability of imposing import quotas in an oil market in which even previously competitive producers thereby acquire an incentive to restrict production (below the quota-restrained level) in an effort to raise the world price. The authors have assumed intermediate-run elasticities and nondisrupted supply conditions. In that context their simulations demonstrate sizeable impacts on price, upward even for very small quota-induced import reductions but eventually turning downward for larger reductions. The greater the size of the consuming unit limiting its imports, the greater the price impact of any given absolute import reduction.

2960 Electric Power

REFER ALSO TO CITATION(S) 5415, 5416, 5417, 5772, 5879

5910 **(DOE/SF/00098—H1) Designing PURPA [Public Utilities Regulatory Policies Act] power purchase auctions: Theory and practice.** (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88002826/JAW.

The Public Utilities Regulatory Act (PURPA) requires there to be procedures for electric utilities to buy electric power from qualifying cogenerators and small power producers (QFs) at rates up to "avoided cost". This has led to price-posting procedures at prices calculated as the utility's marginal cost. Unexpectedly large sales at these prices and slow adjustment to falling energy cost are partially responsible for payments to QFs in excess of the utility's true avoided cost. Using competitive bidding instead of posted prices has been proposed as a way to avoid this outcome. This report reviews bidding theory and explores four issues that arise in designing auction systems for the purchase of power from QFs under PURPA.

5911 (EPRI-P—5417, pp 14.1-14.10) **Role of competition and bulk power transfers in electric utility fuel supply planning.** Pfeffer, J.L. (Pfeffer, Lindsay & Associates, Inc., Washington, DC). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The 1980s mark the beginning of a gradual shift in the traditional power supply acquisition and ownership arrangements among many electric utilities. In an effort to accommodate a more competitive market structure and respond to the growing risks of constructing a new plant, utilities are changing their traditional bulk power and fuel supply arrangements and are becoming increasingly sensitive to the competitive and risk allocation implications of a wide range of system planning and operating practices. The traditional model of vertically integrated electric utilities constructing sufficient generating capacity with secure long-term fuel supplies to provide the major share of power needs for their retail and wholesale customers pursuant to a legal service obligation is changing in response to increasing regulatory risks and new market forces. The principal changes are described.

5912 (EPRI-P—5417, pp 15.1-15.8) **Bulk power transfers: the seller's side.** Meier, J.O. (Southern Co. Services, Inc., Birmingham, AL). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

The Southern Company is an electric utility holding company located in the southeastern US. The Southern Company has four operating companies - Alabama Power Company, Georgia Power Company, Gulf Power Company and Mississippi Power Company. The four companies have a combined installed generating capacity of some 25,000 megawatts. The generation mix is dominated heavily by coal, with about 85% coal, 10% nuclear and 5% hydro. Very little oil and gas generation is used on the system except as peaking capacity. Construction underway includes four coal-powered units and two nuclear units. The combined coal burn for the last couple of years has been in the 45 million ton a year range. It is expected that the annual coal burn will decrease to about 42 million tons over the next five years. The Southern Company off-system sales, that is sales of capacity to neighboring utilities, is discussed. There are two parts to the equation, one being capacity sales, the other being energy sales. The energy side of that equation is addressed, focusing on how these sales have impacted on the fuel procurement and fuel planning functions in the company.

5913 (EPRI-P—5417, pp 16.1-16.14) **Future electric supply and demand: an overview.** Gent, M.R. (North American Electric Reliability Council, Princeton, NJ). Sep 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920002/JAW.

In Proceedings: 1986 fuel supply seminar.

An assessment of the reliability of North America's electric supply systems is presented. There are two parts to reliability; adequacy and security. Adequacy means that there are sufficient facilities to supply the electricity that is being demanded at all times. Security means that the electric systems can withstand sudden disturbances, such as electric short circuits or the unanticipated failure of system components, and still be able to deliver are adequate supply of electric power. Priorities for transmission reliability are discussed.

5914 **(GAO/RCED—86-79) Nuclear science: Information on DOE accelerators should be better disclosed in the budget.** (General Accounting Office, Washington, DC (USA)). 1986. 98p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

GAO estimated the total cost of six of the Department of Energy's largest accelerator projects to be about $6.9 billion. DOE has identified only about $0.6 billion of these project-specific costs in the budget. This is because DOE's definition of a project relates only to construction, which excludes certain project-specific components and preconstruction research and development. In addition, DOE funds a project in stages over a number of years and does not, when the first stage is authorized, identify for the Congress the total cost of completing the project. DOE also does not fully disclose in its budget technical uncertainties associated with the performance of certain accelerator components because its internal operating procedures do not require such disclosure. This could result in cost overruns or increased operating costs.

5915 **(GAO/RCED—86-101) Rural cooperatives: Information on two rural electrification administration proposals.** (General Accounting Office, Washington, DC (USA)). 1986. 35p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

In response to the Rural Electrification Administration's proposal to eliminate its engineering standards divisions, GAO found that (1) the advantages of retaining REA's technical standards-setting functions far exceed the disadvantages; (2) adopting and applying industry standards would not be an acceptable alternative to REA's standards; (3) it would be impractical for REA to impose a fee to all users of its engineering standards but a fee charged to the cooperatives, as a percent of the loans they receive, appears practical; (4) abolishing all technical standards would have an adverse effect on REA's program to assist rural utilities; and (5) approved staffing pattern for both standards divisions stayed at the same level from FY 1983 to FY 1985. GAO also responded to REA's proposal to revise its criteria for loans and advances.

5916 **(GAO/RCED—86-119) Canadian power imports: A growing source of U.S. supply.** (General Accounting Office, Washington, DC (USA)). 1986. 63p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Under existing contractual arrangements, the amount of Canadian electricity imported by U.S. utilities is expected to continue increasing through 1995. If ongoing contract negotiations between U.S. and Canadian utilities are successful, the use of imports will continue to grow beyond the year 2000. It appears that in the future, imports will be used more extensively as a substitute for building new power plants in the United States. GAO found that the basis for pricing imported power differed between the New England and Midwest regions; the current purchases of Canadian power do not exceed levels considered acceptable utility and regulatory officials; and concerning the issue of technicareliability and the potential for transmitting surplus domestic power between regions, industry groups and utilities have been examining these matters to resolve the concerns.

5917 **(GAO/RCED—86-186BR) Federal electric power: Pricing alternatives for power marketed by the Department of Energy.** (General Accounting Office, Washington, DC (USA)). 1986. 42p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Department of Energy's Power Marketing Administrations price and deliver power from 128 hydroelectric power generating facilities in 33 states. Federal laws and regulations require PMAs to establish power rates at levels necessary to ensure that power sale revenues are sufficient to recover all related costs and some irrigation project costs. The government has not intended that power marketing activities make a profit. Certain changes to current PMA power pricing practices could more fully identify and recover the government's costs or, in some cases, result in revenues in excess of costs. Cost-of-service pricing alternatives, for instance, would generally reduce or eliminate under-recovery of costs and result in power pricing methods that are more consistent with nonfederal electric utilities. For alternatives based on criteria other than cost of service, revenues in excess of costs could result.

5918 **(GAO/RCED—87-6) Federal electric power: A five-year status report on the Pacific Northwest Power Act.** (General Accounting Office, Washington, DC (USA)). 1987. 73p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Northwest Power Act established a regional planning council to develop a plan to meet the region's future electricity needs and a program to protect and enhance the region's fish and wildlife resources. Progress has been made in implementing the Council's plan and program but progress has been less than the Council anticipated. The Council and Bonneville Power Administration, which supplies about half the region's electric power, have developed and are carrying out activities to inform the public about regional power matters and to solicit public comments and views on proposed plans prior to making final decisions.

5919 **Real time disturbance recognition in electric power systems.** Mealy, G.L. (The Analytic Sciences Corp., Reading, MA). pp 1960-1961 of Proceedings of the 1986 American control conference. Piscataway, NJ; IEEE Service Center (1986). (CONF-860638—Vol.1).

From American control conference; Seattle, WA, USA (18 Jun 1986).

Computer technology in the eighties is at a level of maturity that could support the automatic identification and mitigation of disruptions of normal operations in electric power systems. However, it still remains a challenge to achieve this in real time and without substantial human intervention. The Analytic Sciences Corporation (TASC) is currently under contract to the Department of Energy to develop a computer-aided methodology for the on-line detection and identification of abnormal operating conditions. TASC's approach to the on-line recognition of major disturbances involves decomposing the power system into smaller subsystems for which real time processing is feasible and developing decentralized structures for sensing, identifying and estimating disturbances.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 5412, 5415, 5416, 5417, 5418, 5671

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 5400, 5671, 5683

5920 **(NEI-SE—12) Environmental consequences of energy categories based on renewable energy sources.** St. Jernquist, I. (Lund Univ. (Sweden). Dept. of Geology). 1986. 272p. (In Swedish). NTIS (US Sales Only), PC A12. Order Number DE88750404/JAW.

The report deals with the following topics: Survey of the state of the art and current experience of environmental effects in Scandinavia. Analysis of environmental effects of the energy systems utilizing solar and renewable energy sources. Analysis of the need of environmental research and recommendation for Scandinavian cooporation. (G.B.).

30 DIRECT ENERGY CONVERSION

3005 Fuel Cells

REFER ALSO TO CITATION(S) 5690

5921 **(N—87-27324) Regenerative fuel cell study for satellites in GEO orbit. Final contractor report.** Levy, A.; Vandine, L.L.; Stedman, J.K. (International Fuel Cells Corp., South Windsor, CT (USA)). Jul 1987. 82p. (NASA-CR—179609; NAS—1.26:179609; FCR—8347). NTIS, PC A05/MF A01.

Summarized are the results of a 12-month study to identify high performance regenerative hydrogen-oxygen fuel cell concepts for geosynchronous satellite application. Emphasis was placed on concepts with the potential for high energy density (W-hr/lb) and

passive means for water and heat management to maximize system reliability. Both polymer membrane and alkaline electrolyte fuel cells were considered, with emphasis on the alkaline cell because of its high performance, advanced state of development, and proven ability to operate in a launch and space environment. Three alkaline system concepts were studied. The first, the integrated design, utilized a configuration in which the fuel cell and electrolysis cells are alternately stacked inside a pressure vessel. Product water is transferred by diffusion during electrolysis and waste heat is conducted through the pressure wall, thus using completely passive means for transfer and control. The second alkaline system, the dedicated design, uses a separate fuel cell and electrolysis stack so that each unit can be optimized in size and weight based on its orbital operating period. The third design was a dual function stack configuration, in which each cell can operate in both fuel cell and electrolysis mode, thus eliminating the need for two separate stacks and associated equipment. Results indicate that using near term technology energy densities between 46 and 52 W-hr/lb can be achieved at efficiencies of 55 percent. System densities of 115 W-hr/lb are contemplated.

5922 **(N—87-28188) Development of an alkaline fuel cell subsystem. Final program summary report, 10 April 1986-31 March 1987.** (International Fuel Cells Corp., South Windsor, CT (USA)). Mar 1987. 94p. (NASA-CR—172002; NAS—1.26:172002). NTIS, PC A05/MF A01.

A two task program was initiated to develop advanced fuel cell components which could be assembled into an alkaline power section for the Space Station Prototype (SSP) fuel cell subsystem. The first task was to establish a preliminary SSP power section design to be representative of the 200 cell Space Station power section. The second task was to conduct tooling and fabrication trials and fabrication of selected cell stack components. A lightweight, reliable cell stack design suitable for the SSP regenerative fuel cell power plant was completed. The design meets NASA's preliminary requirements for future multikilowatt Space Station missions. Cell stack component fabrication and tooling trials demonstrated cell components of the SSP stack design of the 1.0 sq ft area can be manufactured using techniques and methods previously evaluated and developed.

5923 **(PB—87-235693/XAB) Improved acid electrolytes - the synthesis and structure of fluorine-containing sulfonic acids for fuel cells. Annual report, July 1986-July 1987.** Gard, G.L. (Portland State Univ., OR (USA)). Jul 1987. 23p. NTIS, PC A02/MF A01.

See also report for July 1985-July 1986, PB—86-243722.

Twelve fluorosulfonic acids/salts were prepared or purified. Also, sixteen fluoroesters (precursors to sulfonic acids) have been prepared and characterized. Eight-acid systems have been submitted to Dr. Ross (Lawrence Berkeley Labs), four samples to Dr. Maricle (International Fuel Cells) and five samples to Dr. Freese (Stanford Research Institute) for evaluation.

3008 Miscellaneous Converters

5924 **(AD-A—184381/2/XAB) Metal intercalation characteristics of n-HfS_2 photoelectrodes in nonaqueous electrolytes. Technical report No. 1, October 1986-May 1987.** Semkow, K.W.; Pujare, N.U.; Sammells, A.F. (Eltron Research, Inc., Aurora, IL (USA)). Jul 1987. 4p. NTIS, PC A02/MF A01.

The photoelectrochemical (PEC) performance of single-crystal n-hafnium disulfide was correlated with capacitance and impedance measurements obtained with the photoanode van der Waals layers oriented either parallel or perpendicular to acetonitrile-based nonaqueous electrolytes, with and without copper chloride introduced as an intercalating redox species. For van der Waals layers, perpendicular to the electrolyte (i.e., available for copper intercalation) space-charge capacitance values of respectively .01 and 1 microfarad/sq. cm were obtained for the non-intercalated and copper-intercalated photoelectrodes. The implications of these experimental observations were discussed in relation to the application of these intercalating photoelectrodes in both liquid non-aqueous and solid-polymer-electrolyte PEC storage devices.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

5925 **Environmental and economic considerations in energy utilization.** Reynolds, J. Ann Arbor, MI; Ann Arbor Science (1981). 595p.

Ann Arbor Science, P.O. Box 1425, Ann Arbor, MI 48106 $59.95.

This book explores the critical balance between energy, environmental and economic issues. Leading experts present state-of-the-art findings on: industrial energy usage and conservation; regulatory impact; feasibility of synthetic fuels development; innovative process and control technologies; developments in solar energy; mining and smelting operations; and consequences of energy development on American Indian reservations.

3201 Buildings

REFER ALSO TO CITATION(S) 5950, 5974, 6242, 6285

5926 **(EPRI-EM—5463) Personal computer software for lighting design and analysis: Final report.** Isaksen, L. (Analysis and Control of Energy Systems, Inc., Martinez, CA (USA)). Oct 1987. 43p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920068/JAW.

A survey was conducted to identify and describe commercially-available, personal-computer software programs for lighting design and analysis. Twenty-two programs from fourteen vendors were identified. The use of these programs may help electric utilities and their customers, designers and specifiers, and manufacturers and their representatives make better use of lighting. The programs are classified into four categories according to the method they use and their major application: Indoor Point Method, Indoor Zonal Method, Outdoor Point Method, and Economic Analysis. The major findings from the survey are provided in a set of summary tables for each of the categories: Background and Availability, Computer Requirements, User Features, and Capabilities. These tables are supplemented by summary descriptions of each of the programs. 5 refs., 17 tabs.

5927 **(EUR—10449-Pt.2) Development of energy efficient electrical household appliances: Part 2, Cooking: Final report.** Holck, J.; Goldschmidt, L.B.; Heeboll, J.; Pedersen, N.H. (Danmarks Tekniske Hoejskole, Lyngby). 1986. 76p. NTIS (US Sales Only), PC A05. Order Number DE88900205/JAW.

This work has been focussed on the development of a small, highly insulated electric oven, low heat-capacity hot plates and an accurate electronic thermostat for electric hot plates. The work with energy saving ovens can not be said to be finished, even though the prototypes save more than our objective. However, it has proved, that energy saving ovens can be built with good energy economy and at a reasonable price. Experiments with low heat-capacity hot plates made of aluminum have been carried out. Theoretical calculations have indicated possible energy savings around 20%, but the difficulties in producing such hot plates have proved to be considerable. It has also been illustrated that a significant electricity saving, namely 20%, may be obtained by supplying electric cookers with an accurate thermostat. This corresponds to an electricity saving of 1% on a national basis. An experimental microprocessor based setup has been built for the investigation of different principles of control. Two principles have been examined: direct substitution in the model equations and prediction of the pan bottom temperature. A small study was conducted of the efficiency of boiling water in different ways. If it is assumed that electric kettles will be used instead of normal hot plates for boiling water, combined with the use of the controller and the oven described in this report, a savings in electricity for cooking of more than the 50% can be achieved. 13 refs., 26 figs., 5 tabs.

5928 **(EUR—10449-Pt.3) Development of energy efficient electrical household appliances: Part 3, Washing machines: Final report.** Heeboell, J.; Norgard, J. (Danmarks Tekniske Hoejskole, Lyngby). 1986. 44p. NTIS (US Sales Only), PC A03. Order Number DE88900206/JAW.

This report describes work on designing more energy efficient appliances. The objective of this project was to develop and build a prototype of a low energy washing machine, making it possible to do the washing with only around 15 percent of the electricity typically consumed in 1975. 16 refs., 13 figs., 10 tabs.

5929 **(EUR—10550) Contributions to the criteria improvements for design and construction of industrial buildings through a rational use of energy necessary for space heating: Final report.** (Fiat Engineering S.p.A., Torino (Italy)). 1986. 90p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900170/JAW.

At present, energy consumption for space heating of industrial buildings is an important amount of the total energy balance in the industrial countries. Several energy saving investigations carried out on industrial plants emphasized important inefficiencies in space heating. These inefficiencies may be reduced through a better design of the "building-systems". This investigation aimed to determine criteria both for design of new industrial buildings and for retrofit on existing ones.

5930 **(LUTMDN/TMVK—5148-1-73-1986) Absorption heat pump at Ystad; identification, measurement, modelling and simulation.** Wilson, M., Lundh, K. (Lund Univ. (Sweden). Dept. of Heat and Power Engineering). 5 Sep 1986. 66p. (In Swedish). NTIS (US Sales Only), PC A04/MF A011. Order Number DE88750416/JAW.

A statistical model of an absorption heat pump for the indoor bath at Ystad is presented. Measurement were made under realistic operational conditions. Equations, experimental and physicaal data were used to describe the heat pump. Working fluids were LiBr-H/sub2/O. The computer code is attached containing i.a. LiBr routines. (L.E.).

5931 **(ORNL/M—431) Roof Research Center update.** (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001863/JAW.

The Large Scale Climate Simulator (LSCS) will allow samples of typical roofs up to 12 x 12 ft to be placed between environmental chambers, one simulating the indoors and the other a range of controllable outdoor conditions representing a wide range of world environments. Real-time monitoring sensors indicating thermal, moisture, and mechanical performance will provide the data base analysts to develop a fundamental understanding of roof system behavior.

5932 **(ORNL/TM—10279) Evaluation of infrared radiant heaters for Army applications.** Kedl, R.J. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002188/JAW.

This report evaluates the use of infrared radiant heaters for Army applications. Radiant-heater operation and the kinds of heaters available are described. Based on information published in the literature and furnished by the manufacturers, energy savings of 20 to 50% can be expected, compared with conventional heating systems. The greatest savings are usually associated with large industrial-type buildings with high roofs, poor insulation, and high infiltration. High-bay maintenance shops and aircraft hangars, which are common in the Army, are ideal candidates for gas- or oil-fired radiant heaters (both new and retrofit applications). A simple payback period of 2 to 5 years is estimated achievable for a retrofit installation when the fuel cost is $4/MBtu or more and the fuel savings are 40% or more. A program that would lead to a better understanding of the fuel saving potential for different classes of buildings is recommended.

5933 **(PB—87-223079/XAB) M and E (mechanical and electrical) engineering guide. Volume 5. Maintenance.** (Property Services Agency, Croydon (UK). Directorate of M and E Engineering Services). Jan 1987. 277p. NTIS, PC E12/MF E12.

See also Volume 4, PB—87-223061 and Volume 6, PB—87-223087.

Contents include: automatic controls - heating design; automatic controls - heating operation; automatic controls - air conditioning; computer-based building-management systems; noise and vibration; lift and mechanical-handling equipment; and energy conservation.

5934 **(PB—87-223087/XAB) M and E (mechanical and electrical) engineering guide. Volume 6. Maintenance.** (Property Services Agency, Croydon (UK). Directorate of M and E Engineering Services). Dec 1986. 379p. NTIS, PC E16/MF E16.

See also Volume 5, PB—87-223079 and Volume 7, PB—87-223095.

Contents include: prime movers, generators and PSA power supplies; transmission and distribution; LV electrical installations and equipment; installations in potentially hazardous areas; lighting (excluding AGL); aviation ground lighting; lightning protection; fire-detection alarm and extinguishing systems; television and sound radio systems; sound systems; control and supervisory systems; standard symbols.

5935 **(PB—87-235727/XAB) Applications assessment for gas engine-driven chillers. Topical report.** O'Farrell, P.M. (Technical Marketing Associates, Inc., Sudbury, MA (USA)). Nov 1986. 139p. (TE—4373-32-87). NTIS, PC A07/MF A01.

The report assesses the potential of gas engine-driven chillers in commercial HVAC and evaluates suitable applications. Market information is provided on existing HVAC products, with emphasis on water chillers. The history of engine chillers is reviewed, with factors which contributed to their growth and their later decline during the 60's. Benefits of using an engine prime mover are explained, along with other load-shifting options available to commercial buildings. An overview of building trends and owner/developer characteristics is included. Finally, the potential impact on summer gas use is assessed, as well as issues that affect commercialization.

5936 **(SBI-R—185) Energy saving measures of a low-dense housing estate. Technical arrangements and information directed at residents.** Brorsen, S.; Petersen, K.B. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1987. 40p. (In Danish). Statens Byggeforskningsinstitut, DK-2970 Hoersholm.

Since the energy crisis in 1973/1974 considerable investments have been made in technical installations in order to reduce energy consumption in connection with space heating and hot water. In this project previous experience within the field of energy saving motivated the study of the following questions: a) To which extent can saving be attributed to investments in energy saving installations? b) To which extent will information on the possibilities of energy saving have effect? c) Which procedure should be chosen to make energy saving measures permanent? The project was carried out on a housing estate of atrium houses. The 58 houses were divided into 3 groups as follows: 1. A reference group was kept apart from all influence as far as posssible (20 houses). 2. An installation group was provided with equipment for automatic regulation of energy saving of space heating as well as equipment to limit the consumption of hot water. The residents were thoroughly informed about the application of the equipment (18 houses). 3. An information group only received general information in writing followed up by a discussion of some length about the possibilities of each individual household of energy savings on a daily basis (20 houses). The results registered indicate that a reduction of the energy consumption in relation to space heating of the heating estate did take place. Energy saving measures seem to be maintained for a longer period within the installation group.

5937 **(EPRI-P—4463-SR-Vol.2-Pt.1) TAG: Technical Assessment Guide: Volume 2, Electricity end use: Part 1, Residential electricity use, 1987: Special report.** Haas, S.M.; Regulinski, S.G.; Sloane, B.D.; Alereza, T.; Bernstein, S.; Isaksen, L.; He, S.; Merriam, R.L. (Decision Focus, Inc., Palo Alto, CA (USA); Synergic Resources Corp., Seattle, WA (USA); ADM Associates, Inc., Sacramento, CA (USA); Energy International, Inc., Bellevue, WA (USA); Analysis and Control of Energy Systems, Inc., Concord, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 244p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920060/JAW.

This Technical Assessment Guide (TAG), prepared by EPRI personnel, has been compiled for the use of EPRI staff and its contractors to provide a common basis for evaluating electric energy R & D alternatives. This fifth edition of the TAG divides the document into four volumes. This volume presents evaluation procedures and data on technologies that use electricity as well as those using other forms of energy. It is divided into three parts covering the residential, commercial, and industrial sectors and describes the levelized annual cost method for making comparisons among technologies from the end-user's point of view. This Document, Volume 2, Part 1 discusses Residential Electricity use.

3202 Transportation

REFER ALSO TO CITATION(S) 5945, 6231

5938 **(NEI-DK—43) Electronic dynamometer and measuring equipment for testing of tractor operation.** Nielsen, V. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)). Feb 1987. 48p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750374/JAW.

The aim of the project has been to develop methods and technique for the efficiency of the farmers' organizations' tractor control, and hereby to reduce the consumption of fuel and the costs of repair. It is attemted to do so by developing a measuring cart with electronic measuring equipment and with EDP for working up, storing and for presentation of measuring results. The measuring equipment consists of: 1. Electronic dynamometer for measuring of the efficiency 2. Electronic fuel flowmeter. 3. Electronic revolution counters. 4. EDP for registration, storing and copying of measuring results. 5. Hydraulic meter for testing the hydraulic system of the tractor. 6. Electronic thermometer for measuring of water - oils and exhaust temperature. 7. Electronic multimeter for examination of the electric system of the tractor, including the battery of the tractor. 8. Smoke meter for measuring the smoke development of the tractor. Test report of nozzles. Various implements. (EG).

5939 **(PB—87-228094/XAB) Estimating the construction-phase impacts of urban mass-transit projects. Final report.** Mahdi, S.I. (Benedict Coll., Columbia, SC (USA)). Feb 1987. 47p. NTIS, PC A03/MF A01.

This study attempts to forecast the impacts of the construction phase of new transit facilities in metropolitan areas. The purpose of the study is to identify and develop an approach, a model and an appropriate methodology to simulate and forecast economic impacts of UMTA-funded new mass-transit systems or any additions to mass-transit facilities in metropolitan areas. Using a forecasting and simulations model conjoined with a 490-sector input/output model, simulated forecasts were generated, predicting the effect of new facilities on the local economy of four UMTA-funded mass-transit systems located in Atlanta, Georgia; Boston, Massachusetts; San Francisco, California; and Washington, D.C.

5940 **(PB—87-229340/XAB) Optimization of left turn phase sequence in signalized networks using MAXBAND 86.** (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Aug 1987. 728p. NTIS, PC E99.

Set includes PB—87-229357 through PB—87-229373.

Separate abstracts are included for the three volumes of this collection.

5941 **(PB—87-229357/XAB) Optimization of left-turn phase sequence in signalized networks using MASBAND 86. Volume 1. Summary report. Final report, August 1984-January 1986.** Messer, C.J.; Hogg, G.L.; Chaudhhary, N.A.; Chang, E.C.P. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Aug 1987. 108p. NTIS, PC A06/MF A01.

See also Volume 2, PB—87-229365; Also available in set of 3 reports PC E99, PB—87-229340.

MAXBAND has been enhanced to provide optimal traffic-signal timing plans for general grid networks, using bandwidth as the criterion. The program is user-friendly and has several new features. Grid networks as large as 20 arterials with up to 20 signalized intersections per arterial could be solved, but present specifications limit the number of signals in the network to 50 until more operational experience with the system is obtained. Phase-sequence optimization is provided together with NEMA, eight-phase numbering. MAXBAND 86 is written in FORTRAN 77. Volume 1, Summary Report, provides the basic model theory for calculating progression bandwidths in arterials. Additional material describes how the arterial model formulation is integrated into closed-network analysis using closed loop equations. An overview of MAXBAND input, operational, and output features are provided.

5942 **(PB—87-229365/XAB) Optimization of left-turn phase sequence in signalized networks using MAXBAND 86. Volume 2. User's manual. Final report, August 1984-January 1986.** Messer, C.J.; Hogg, G.L.; Chaudhary, N.A.; Chang, E.C.P. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Aug 1987. 311p. NTIS, PC A14/MF A01.

See also Volume 1, PB—87-229357, and Volume 3, PB—87-229373; Portions of this document are not fully legible; Also available in a set of 3 reports PC E99, PB—87-229340.

MAXBAND has been enhanced to provide optimal traffic-signal timing plans for general grid networks, using bandwidth as the criterion. The program is user-friendly and has several new features. Volume 2, MAXBAND 86 User's Manual, gives a detailed description of the features of the program and their use, including data entry, program control, and optimal-solution outputs. Four sample problems are included with examples of their input and output. Details of system enhancements and coding forms are provided in appendices.

5943 **(PB—87-229373/XAB) Optimization of left-turn phase sequence in signalized networks using MAXBAND 86. Volume 3. Program manual. Final report, August 1084-January 1986.** Chaudhary, N.A.; Chang, E.C.P. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Aug 1987. 310p. NTIS, PC A14/MF A01.

See also Volume 2, PB—87-229365; Also available in set of 3 reports PC E99, PB—87-229340.

MAXBAND has been enhanced to provide the capability of computing traffic-signal timing plans for general grid networks, using bandwidth as a criterion. The revised program is more user-friendly and has several new features. General grid networks as large as 20 x 20 can be solved. Phase-sequence optimization is provided together with NEMA, eight-phase numbering. MAXBAND is written in FORTRAN 77. Volume 3, MAXBAND Programmer's Manual, gives detailed descriptions of the subroutines composing the MAXBAND program as developed using structured programming technology. Each description includes the purpose and function of the subroutine, how it is related to other subroutines, and the variables which it uses. Other than features that have been altered, no attempt is made to document the MPCODE Mathematical Programming System, portions of which are included in the MAXBAND program.

5944 **(SJF-BERETNING—28) Fuel control in agricultural tractors.** Nielsen, V. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)). Feb 1987. 25p. (In Danish). NTIS (US Sales Only), PC A02. Order Number DE88750373/JAW.

Since the energy crisis in the beginning of the -seventies various research projects have been carried out with the aim of reducing the energy import of the energy import of the country. The aim

of the present project is to develop methods for controlling the fuel consumption for agricultural tractors, in a way that the tractor driver is continually being kept informed of the fuel economy. It has been attempted to do so in two different ways: 1. Direct measuring of fuel. 2. Indirect measuring of fuel.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 6430, 6482

5945 **(AD-A—184199/8/XAB) Asphalt hot-mix recycling. Master's thesis.** Watts, D.L. (Florida Univ., Gainesville (USA)). 1987. 128p. NTIS, PC A07/MF A01.

This paper discusses various key elements of the asphalt hot-mix recycling process. A number of observations concerning the entire process were made. The first of these items is that the asphalt hot-mix recycling process should be viewed as one of a number of rehabilitative alternatives. The advantages and disadvantages of the various rehabilitative alternatives, including hot-mix recycling, must then be kept in mind when choosing the best alternative for the given situation.

5946 **(DOE/OR/00033—T353) Roles of electricity: Agriculture.** Burwell, C.C. (Oak Ridge Associated Universities, Inc., TN (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. Contract AC05-76OR00033. 19p. Electric Power Research Institute, 3412 Hillview Ave., Box 10412, Palo Alto, CA 94303. Order Number TI88001871/JAW.

In energy terms, agricultural practice and technology have moved from an agricultural system totally dependent on human, animal, and solar energy to one heavily dependent on motor fuels to one with major energy contributions from natural gas and electricity. From 1940 when only 25% of the US farmhouses had minimal electrical service, the use of electricity for agricultural production has grown to 54 billion kWh annually equaling 22% of the primary energy used for agricultural production. The growing importance of electricity in recent years derives in large part from its use for delivering irrigation water, for producing agricultural chemicals, and for raising livestock. This paper presents data reflecting these facts. 56 refs., 19 figs., 12 tabs.

5947 **(DTH-LFK—F106-01) Grain drying plant with heat pump. Indirect evaporation and condensing.** Elefsen, F. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Koeleteknik). Dec 1986. 16p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750391/JAW.

Computerized simulations of a grain dryer with indirect evaporation and condensing are assessed. The simulations show that the thermal efficiency and performance/hour are reduced by 2-12% depending on the operating conditions compared with a dryer with direct evaporation and condensing. The largest reduction is obtained by maximum of aeration factor and minimum of number of revolutions. Optimum operation is changed by using indirect evaporation and condensing. (LN).

5948 **(EPRI-EM—5418) Electrotechnologies for waste and water treatment: Final report.** Estey, P.; Hampton, H.; Sefidpour, S. (Science Applications International Corp., Los Altos, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 315p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920055/JAW.

This work identifies and examines the use of electrotechnologies in the treatment of solid and liquid wastes. The types of wastes studied were divided into five major classifications: (1) municipal solid wastes, (2) municipal wastewater, (3) nonhazardous industrial wastes, (4) hazardous industrial wastes and (5) nuclear wastes. Within each category, information was gathered on the quantities of waste generated, types of wastes generated, current disposal or treatment technologies, research on promising treatment technologies, and energy usage for current and promising technologies. Information in the above areas was also put together for the topics of drinking water and resource recovery. 71 refs., 71 figs., 91 tabs.

5949 **(EPRI-EM—5445) Technoeconomic assessment of electric steelmaking through the year 2000: Final report.** Bosley, J.J. (ed.); Clark, J.P.; Dancy, T.E.; Fruehan, R.J.; McIntyre, E.H. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Metals Production; Steelcon, Inc., Pittsburgh, PA (USA)). Oct 1987. 230p. NTIS, PC A11/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88002254/JAW.

The electric steelmaking industry may soon account for 40% of US steel production. This assessment of existing and potential electric arc furnace capacity includes R and D recommendations for minimizing energy consumption and optimizing output. 20 figs., 63 tabs.

5950 **(EPRI-EM—5464) Heat recovery heat pumps in commercial buildings: Final report.** Redden, G.H. (Dames and Moore, Bethesda, MD (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 129p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920057/JAW.

This report studies the characteristics, applicability, and economic feasibility of space and water heating using heat recovered from electrically driven chiller-based air conditioning systems. The report identifies and characterizes currently available heat recovery equipment types, describes how they fit into existing and new commercial buildings, and estimates cost effectiveness based on payback as a function of building type, size, use, and climate. Manufacturers' market assessments and institutional barriers are also discussed. Market potential for applicable building types is identified, along with research projects for developing and maximizing the market potential of heat recovery systems. There is little opportunity for significant improvement in equipment performance or cost reduction. Research recommendations focus on improving application and marketing information and techniques. 11 refs., 51 figs., 5 tabs.

5951 **(EUR—9880) Energy saving in the use of new thermal cycles applied to foundry pieces unmolded in heat just after finish of solidification: Final report.** Bak, C.; Bellocci, R.; Schissler, J.M.; Saverna, J. (Centre de Recherches de Pont a Mousson, 54 (France). Div. Metallurgie; Institut National Polytechnique de Lorraine, 54 - Nancy (France)). 1985. 141p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88900125/JAW.

The previous comparative studies were completed during this last period by obtaining bainitic SG Cast Iron. The previous results were verified through the application of bainitic and pearlitic treatments to a mechanical part with variable cross section, and with gates and risers. No problems arose on the metallurgical level and mechanical properties were in agreement with those obtained on test specimens. Concluding this application the steps of an industrial production process were defined and analyzed as well as the application range of such a process. The main interest was found for automated mass production.

5952 **(EUR—10553) Heat pump for heat recovery from a paper dryer; production of dry air from operation steam.** Friedel, W.; Gramatte, W.; Hampel, H.J.; Schneider, R.; Wittekind, J.; Vack, K.; Ruediger, B. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). 1986. 121p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900134/JAW.

Different possibilities have been studied to produce heat at 125 - 145° for a paper dryer from its waste heat at 80 - 90C. A comparison of the possible systems was made regarding technical feasibility, energy saving potential and costs. The two-staged absorption heat pump with LiBr/H_2O was found to be able to work under the specific operating conditions of the reference paper machine. A 100 kW heat pump of this type was built and tested on a test rig. As a result of these tests the following modifications are being brought about: installation of a pump to control the solution and avoid crystallization of LiBr; continuous measurement of the LiBr concentration; design of a new LiBr solution distribution system; and replacement of the solution heat exchanger by a new apparatus with low losses.

5953 **(EUR—10807) Development and construction of a reversed absorption heat pump on site to raise industrial waste heat to the desired useful heat level: Final report.** Engelhard, J.; Struck, W.; Moetz, K. (M.A.N. Technologie G.m.b.H., Muenchen (Germany, F.R.)). 1986. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900132/JAW.

A heat transformer with NH_3/H_2O as a working fluid pair has been developed which converts industrial waste heat of 80°C into steam of 130°C (3 bar) without further need of fuel or power. A heat transformer is a reversed absorption heat pump. In a normal absorption heat pump, high temperature heat is used in the generator, low temperature waste heat is absorbed in the evaporator and medium temperature heat is extracted from the absorber and condenser. In a heat transformer, medium temperature waste heat is given to the generator and evaporator, high temperature heat is extracted from the absorber and low temperature heat is discharged at the condenser. The amount of high temperature heat is only a fraction of the medium temperature waste heat used in the generator and evaporator. For the heat transformer which has been developed, the amount of heat at 135°C delivered by the absorber is about 30% of the waste heat around 100°C given to the generator and evaporator. The system produced 3.3 kW heat (steam) at 135°C and operated satisfactorily. 10 refs., 33 figs.

5954 **(GAO/NSIAD—86-60) Hazardous waste: DOD's efforts to improve management of generation, storage, and disposal.** (General Accounting Office, Washington, DC (USA)). 1986. 91p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Many Department of Defense installations have yet to achieve full compliance to dispose of hazardous waste and construct storage facilities a timely manner. In addition, DOD could do more to reduce the volume waste requiring disposal. DOD addressed the situation through a policy change that emphasizes that the services, their commands, and installation commanders have maximum authority and flexibility to achieve compliance with the Resource Conservation and Recovery Act. DOD also adopted a policy requiring audits of installation compliance, and plans to change its environmental management information system so it can measure the success of the services in carrying out DOD policies and programs.

5955 **(GAO/NSIAD—86-68BR) Hazardous waste: Review of selected Air Force hazardous waste reports.** (General Accounting Office, Washington, DC (USA)). 1986. 13p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO reviewed 30 contractor-developed Air Force Installation Restoration Program Phase I reports which identify areas of potential environmental contamination due to hazardous waste disposal and assess the probability of contaminant migration that could adversely affect public health and/or the environment. Each potential hazardous waste site is rated using the Air Force's Hazard Assessment Rating Methodology and is assigned a HARM score.

5956 **(GAO/PEMD—87-11BR) Hazardous waste: Uncertainties of existing data.** (General Accounting Office, Washington, DC (USA)). 1987. 42p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO is not able to determine whether the nation has sufficient capacity to manage the volume of hazardous waste being produced now and projected for the future because of inadequacies in the national data base. Further, these inadequacies severely constrain the planning and management of future hazardous waste production. Significant data gaps, methodological problems, and other issues prohibit reliance on available information to provide estimates of the total volume of hazardous waste and determination of whether future treatment, storage, and disposal capacity will be quantitatively adequately to meet the volume of hazardous waste generated.

5957 **(GAO/RCED—86-76) Hazardous waste: Federal civil agencies slow to comply with regulatory requirements.** (General Accounting Office, Washington, DC (USA)). 1986. 61p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Federal agency performance in implementing the Resource Conservation and Recovery Act of 1976 has not been exemplary. Agencies have been slow in developing an awareness and understanding of their responsibilities under the act and in establishing programs to carry out the act's requirements. A complete inventory of federal hazardous waste handlers has yet to be developed by the agencies. Over 70 percent of the identified handlers reviewed had not been inspected, and of those that have been inspected, almost half had violations. Agency actions to correct identified problems have taken extended periods of time, and few enforcement actions, other than warning letters, have been used by the Environmental Protection Agency or the states to elicit greater agency attention to problems.

5958 **(GAO/RCED—86-123) Hazardous waste: Responsible party clean up efforts require improved oversight.** (General Accounting Office, Washington, DC (USA)). 1986. 32p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

As of June 1985, the Environmental Protection Agency had negotiated 158 responsible party settlements, worth an estimated $417 million, for cleaning up hazardous conditions at waste sites. About half of the settlements (72) were for long-term site cleanup activities; the remainder were for short-term emergency cleanup actions. EPA does not have a coordinated, systematic structure for overseeing responsible party compliance with settlement terms. Settlement oversight and enforcement decisions are left to each project manager's judgment, without the benefit of formal guidance, procedures, and documentation standards. This has not only caused delays in identifying and resolving problems but has also resulted in infrequent enforcement actions.

5959 **(GAO/RCED—86-178BR) Hazardous waste: EPA's consideration of permanent cleanup remedies.** (General Accounting Office, Washington, DC (USA)). 1986. 33p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

In the first 5 years of the Superfund program, the Environmental Protection Agency selected permanent treatment technologies as cleanup remedies in 27 of 121 cleanup decisions, with incineration being selected in 13 of the 27 decisions. EPA did not select permanent treatment technologies more often because they were considered too costly or their effectiveness had not yet been proven. However, EPA did select them more frequently each year in support of its policy but a number of barriers will hinder further progress toward this objective. To overcome the barriers EPA has established the Superfund Innovative Technology Evaluation Program and has created several tasks forces to develop strategies, policy guidance, and other solutions for dealing with the problems.

5960 **(KVL-JI-MEDD—56) Small scale grain processing schemes in Africa. Methods, equipment, energy and power requirement, use of renewable energy resources.** Vanek, K.V. (Kongelige Veterinaer- og Landbohoejskole, Tastrup (Denmark). Jordbrugsteknisk Inst.). Dec 1986. 112p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750387/JAW.

The current methods of processing agricultural products in rural areas of developing countries are analysed from the point of view of energy and power requirements. Special attention is paid to grain grinding and dehulling, to rice processing and to the drying of agricultural products. The currently used manual processing methods are surprisingly energy efficient, therefore, the prospects of replacing them by human power operated machines are rather limited. The size of mechanically powered equipment is given by the size of engines, mostly diesel engines. As the diesel engines are available from around 4 kW, the equipment designed for village use is frequently overdimensioned and thus poorly utilized. A concept of lower power and lower capacity equipment is discussed. It is concluded that a 1.5 kW grinder and a 1.5 kW dehuller of specified

types would be sufficient for a village of 100 inhabitants. Similarly, the drying operation could be significantly improved by using limited amounts of the mechanical energy. The total amount of the mechanical energy for the processing operations are estimated to be 10 to 20 kW/day for a village of 1000 inhabitants. The power requirements throughout the year is relatively even, without large fluctuations. The use of local energy resources and simple energy conversion methods is discussed, particularly the hydropower applications and heat engines. Concerning the hydropower, a system consisting of a hydro-air compressor and compressed air engines is suggested for closer consideration. Rankine type engines and Stirling engines are shortly discussed and assessed from the point of view of the use in rural areas of developing countries. 34 refs.

5961 **(NEI-DK—44) Preliminary project on power saving refrigerators. Part 1. Domestic refrigerators.** Buhl Pedersen, P. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Mar 1987. 50p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750377/JAW.

Electricity used for refrigeration in Denmark is estimated to 3.2 TWh/year, 628 kWh/year per capita or 12.5% of total electricity consumption. Several suggestions to improve electricity efficiency are given in the fields of household-, commercial- and industrial refrigeration. The total potential for electricity savings is estimated to approx. 1.8 TWh/year or 7% of total electricity consumption in Denmark. Distributed, the savings are 1.3 TWh/year or 70% in household refrigeration, 0.2 TWh/year or 50% in commercial refrigeration and 0.3 TWh/year or 30% in industrial refrigeration. All savings assumed are based on known technology. 10 refs.

5962 **(NEI-DK—45) Preliminary project on power saving refrigerators. Part 2. Shop refrigerators.** Buhl Pedersen, P. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Mar 1987. 37p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750378/JAW.

Electricity used for refrigeration in Denmark is estimated to 3.2 TWh/year, 628 kWh/year per capita or 12.5% of total electricity consumption. Several suggestions to improve electricity efficiency are given in the fields of household-, commercial- and industrial refrigeration. The total potential for electricity savings is estimated to approx. 1.8 TWh/year or 7% of total electricity consumption in Denmark. Distributed, the savings are 1.3 TWh/year or 70% in household refrigeration, o,2 TWh/year or 50% in commercial refrigeration and 0.3 TWh/year or 30% in industrial refrigeration. All savings assumed are based on known technology. 44 refs.

5963 **(NEI-DK—46) Preliminary project on power saving refrigerators. Part 3. Industrial refrigerators.** Buhl Pedersen, P. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Mar 1987. 23p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750379/JAW.

Electricity used for refrigeration in Denmark is estimated to 3,2 TWh/year, 628 kWh/year per capita or 12,5 % of total electricity consumption. Several suggestions to improve electricity efficiency are given in the fields of household-, commercial- and industrial refrigeration. The total potential for electricity savings is estimated to approx. 1,8 TWh/year or 7 % of total electricity consumption in Denmark. Distributed, the savings are 1,3 TWh/year or 70 % in household refrigeration, o,2 TWh/year or 50 % in commercial refrigeration and 0,3 TWh/year or 30 % in industrial refrigeration. All savings assumed are based on known technology. 11 refs.

5964 **(PNL-SA—14739) Emerging electrotechnologies in the process industries.** Moore, N.L.; Dirks, J.A.; Wilfert, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 8p. (CONF-8709166—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001901/JAW.

From Annual industry and technology conference; College Station, TX, USA (16 Sep 1987).

One of the most critical issues facing the US electric utility industry and their industrial customers is the replacement of aging equipment within the industrial infrastructure. Selecting the technologies which will use the least overall energy and still enhance product quality is a challenge. The decision between the electric utility and industry to cost share the installation of such equipment must be made on sound facts after examining all alternatives. This paper concentrates on five major industrial groups: food processing, pulp and paper, textiles, chemicals, and petroleum. Our research is focused on identifying the emerging technologies which will affect electrical usage within these five industrial groups. 2 refs.

5965 **(SLU-LBT—46) Non-transparent insulation in greenhouses. Light and energy.** Nilsson, G. (Swedish Univ. of Agricultural Sciences, Garpenberg. Dept. of Operational Efficiency). 1986. 109p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750407/JAW.

Energy measurements were carried out during two periods. During the first period, when only the north walls were insulated, no difference was measured in energy consumption between the asymmetric and the symmetric greenhouse. On the other hand there was a greater energy saving in the asymmetric greenhouse compared to the symmetric during the second period, when even the south walls were insulated. The greater energy saving in the asymmetric greenhouse depends on the fact that shielded insulation, relatively seen, is less, compared to the symmetric. The asymmetric greenhouse has a greater amount of energy which can be used. The light measurements in the greenhouses gave the following indications: -In the asymmetric greenhouse a non-transparent,high reflecting north wall is more profitable than a transparent wall. -In the symmetric greenhouse there is no difference in mean intensity along the non-transparent, high reflecting north wall compared to the transparent.-When comparing the a symmetric and the symmetric greenhouses with non-transparent north walls,a higher light level has been registrated in the asymmetric greenhouse. A model has been constructed for a special case when only one screen is used. This model shows a good conformity with real measurements. The model gives a light reduction close to the screen, of 25-50 percent, varying, depending on the reflectance factor on the screen. The model also shows, that the light reduction is at the greatest within 0-3 meters from the screen. The effect from the screen on energy saving, is great compared to the investment cost. The profitability is calculated as pay-off time for the investment. If no other energy reducing measures have been carried out,the pay-off time will be short, the profitability has been calculated.

5966 **(SLU-LBT-E—55) Fish cultivation with energy from agriculture.** Haegg, A. (Swedish Univ. of Agricultural Sciences, Lund. Dept. of Farm Buildings). Mar 1985. 63p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750399/JAW.

Intensive cultivation of rainbow trout (Salmo gairdneri Richardsson) has been studied. The possibilities of using straw or heat from stables have been evaluated. A market survey for rainbow trout and economical evaluations of two drafts of recirculating cultivation systems have been made. The work is based on a literature survey completed with interviews. (Bok). With 26 refs.

5967 **(STU—83-4388) Energy consumption in farm buildings.** Nilsson, S.; Paahlstorp, S. (Swedish National Board for Technical Development, Stockholm; Swedish Univ. of Agricultural Sciences, Garpenberg. Dept. of Operational Efficiency). 1985. 169p. (In Swedish). (STU—81-3247; SLU-LST-S—141). NTIS (US Sales Only), PC A08. Order Number DE88750403/JAW.

In order to know the energy consumption at different functions in the agriculture, the department of Farm Buildings has done measuring since 1982 at 19 different farms. More than 240 electricity meters have been mounted at farms all over Sweden. The meters have been read by the farmers every week. In most cases it is the electrical consumption, which has been read. Only when monitored at the graindryers the oilenergy is included. The average yearly energy consumption kWh/animalplace for different functions in common productions is shown for dairy cow, young bull, sow, fattening pig and laying hen. The specific energy consumption for grain drying with cold air grain dryers has been in average 23 kWh/ton 15 percents grain at 4 percent drying. Corresponding value for hot air dryers has been 88 kWh/ton. By potato storage and sorting it was in average used 23 kWh/ton sorted potatoes. (authors).

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 5948, 5955, 5956, 5957, 5958, 5959, 6482

5968 **(GAO/RCED—86-96FS) EPA construction grants: Information on the North River Wastewater Treatment Plant contracts.** (General Accounting Office, Washington, DC (USA)). 1986. 25p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

New York City's North River Wastewater Treatment Plant is under construction and about 75 percent of its estimated $1.1 billion cost is to be Federally funded through the Environmental Protection Agency. Neither EPA regulations, the EPA delegation agreement with the State, the grant to the City, nor the solicitations contain limits on the maximum amount of wages that might be earned on construction contracts, EPA relies on the competitive process to obtain reasonable prices for constructing wastewater treatment plants rather than establishing maximum limits on wages.

5969 **(GAO/RCED—86-145) Water resources: Legislation needed to extend the life of confined disposal facilities.** (General Accounting Office, Washington, DC (USA)). 1986. 48p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The U.S. Army Corps of Engineers periodically dredges various harbors in the Great Lakes and elsewhere in the United States. It normally disposes of dredgings by dumping them in open water. Public Law 91-611 authorized the Corps to construct confined disposal facilities for holding contaminated dredgings for a period not to exceed ten years. Concern was raised about whether a disposal facility constructed at Kenosha, Wisconsin, which was less than one-third full but which the Corps was planning to use after the 10-year period, should be closed. GAO believes that P.L. 91-611 does not authorize the Corps to keep such facilities as the one at Kenosha or other locations open beyond the ten years. To continue to use such facilities the Corps should seek, in GAO's opinion, legislation to extend the life of those facilities when local communities are in agreement to an extension. When communities do not agree the Corps should find alternatives for disposing of the contaminated dredgings.

5970 **(GAO/RCED—86-231BR) EPA construction grants: Information on the Milwaukee Area Sewerage System Improvement Program.** (General Accounting Office, Washington, DC (USA)). 1986. 19p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Milwaukee Sewerage Water Pollution Abatement Program was initiated in response to federal and state court lawsuits to halt Lake Michigan's pollution. It is about $360 million under budget and on schedule with a 1996 target completion date. GAO found that the district meets the federal criteria for an eligible grantee; federal and Wisconsin regulations permit architect and engineering contracts to be competitively negotiated and do not require advertised competitive bidding; the job site rule, which limits allowable overhead billings, was not applied because it was determined that the operation of the prime contractor responsible for managing the program and its technical integrity did not constitute a job site; no federal funds have been involved in the disposition of rock from the north shore project site; and the total estimated architect and engineering costs $344.7 million represent about 28 percent of total estimated construction costs.

5971 **(PB—87-206066/XAB) Municipal-waste combustion study.** (Radian Corp., Research Triangle Park, NC (USA)). Sep 1987. 1454p. NTIS, PC E99.

Set includes PB—87-206074 through PB—87-206157.

5972 **(PB—87-206132/XAB) Municipal-waste combustion study: assessment of health risks associated with municipal-waste combustion emissions. Final report.** Cleverly, D.H. (Radian Corp., Research Triangle Park, NC (USA)). Sep 1987. 232p. (RAD—87-239-001-29). NTIS, PC A11/MF A01.

See also PB—87-206157.

This report is an analysis of potential human health risks and environmental effects associated with pollutants emitted to the air from both existing as well as planned municipal-waste combustors in the U.S. Quantitative cancer-risk assessment was restricted to direct inhalation of organic and metal emissions. Limited analysis of indirect exposure pathways, e.g., ingestion and dermal absorption, was performed to qualitatively determine the importance of this exposure relative to direct inhalation. Potential welfare effects were also evaluated. This effort was in support of a regulatory determination of municipal-waste combustor emissions under the Clean Air Act. Pollutants considered in the analysis included: polychlorinated dioxins and dibenzofurans, chlorophenols, chlorobenzenes, formaldehyde, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, arsenic, beryllium, cadmium, hexavalent chromium, lead, mercury, and hydrogen chloride.

5973 **(PB—87-233235/XAB) Municipal-waste-combustion systems - operation and maintenance study. Final report.** Allen, R.D. (Allen Consulting and Engineering, Cary, NC (USA)). Jun 1987. 79p. NTIS, PC A05/MF A01.

The study was undertaken to determine the significant operation and maintenance (O & M) considerations that bear directly on the day in/day out air-pollution-compliance status of municipal-waste combustors (MWC's). Two independent tasks were performed to compile and document these O & M considerations. First, seven MWC sites were visited to interview equipment operators and management personnel to determine the nature of the problems they routinely encounter in operating MWC systems. The information gathered from their visits is reported herein through a description of O & M problems and solutions for each major subsystem in the MWC process. The subsystems discussed include: fuel preparation and handling; furnace operation; ash handling; air pollution control equipment; fans, ducts and stacks; and procedural considerations such as startup/shutdown, equipment inspection, and recordkeeping. Second, a field study was conducted to determine the effect of operating variables on visible emissions (opacity) at one facility. Ninety days of hourly readings of process and opacity data were collected by the MWC staff. An attempt was then made to statistically correlate the process and opacity data.

5974 **(STEV—1987-1) Group centrals for heating. A survey of dwellings, commercial buildings and industry. Oil replacements so far. Planning.** (Statens Energiverk, Stockholm (Sweden)). 22 Dec 1986. 94p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750414/JAW.

Central heating plants supplying heat for large buildings, industries or groups of apartment buildings (here called group centrals), who are not parts of a district heating system, are studied in this report. Special interest is payed to the fuel choice of the plants, to the planned integration into district heating networks and to the potential for conversion to solid fuels combustion or heat pump istallations. (L.E.).

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

5975 **Technology development summary for the AGT101 advanced gas turbine program.** Boyd, G.L.; Kidwell, J.R.; Kreiner, D.M. (Garrett Turbine Engine Co., Phoenix, AZ). pp 23 of International congress and exposition. New York, NY; Society of Automotive Engineers (1987). (CONF-870204—).

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

A summary is presented of significant technology developments that have been made in the AGT101 advanced gas turbine program. The AGT101 design features are reviewed, and the power section testing and results are addressed in detail. The results of component testing and evaluation are described for the compressor, turbine, regenerator, and foil bearing. Ceramic component development is discussed, including that of the static seal, turbine shroud seal, regenerator shield planar seal, regenerator shield piston ring, stator rig, ceramic combustor, and turbine rotor. Important

areas to be addressed by the Advanced Turbine Technology Applications Project now in the planning stage at DOE and NASA are briefly reviewed.

5976 **Advanced Turbine Technology Applications Program (ATTAP).** Kramer, S.B.; Kerwin, P.T.; Schettino, J.C. (DOE, Washington, DC; NASA, Lewis Research Center, Cleveland, OH; ORI, Inc., Rockville, MD). pp 8 of International congress and exposition. New York, NY; Society of Automotive Engineers (1987). (CONF-870204—).

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

The need for advances in ceramic techniques in order to manufacture reliable cost-effective ceramic components for automotive gas turbine engines, in particular in the hot section of the engine, is examined. The objectives of the ATTAP is to establish the reliability of ceramic component designs and materials in automotive gas turbines; to expand the experimental data base in the operation environment; and to complete the development of analytical tools needed to support industry in the successful application of ceramics to long-life turbine engines. The role of industry and the government in the development of the gas turbine engine is discussed.

3302 External Combustion Engines

5977 **Mod II engine performance.** Richey, A.E.; Huang, S.C. (Mechanical Technology, Inc., Latham, NY). pp 8 of International congress and exposition. New York, NY; Society of Automotive Engineers (1987). (CONF-870204—).

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

The testing of a prototype of an automotive Stirling engine, the Mod II, is discussed. The Mod II is a one-piece cast block with a V-4 single-crankshaft configuration and an annular regenerator/cooler design. The initial testing of Mod II concentrated on the basic engine, with auxiliaries driven by power sources external to the engine. The performance of the engine was tested at 720 C set temperature and 820 C tube temperature. At 720 C, it is observed that the power deficiency is speed dependent and linear, with a weak pressure dependency, and at 820 C, the power deficiency is speed and pressure dependent. The effects of buoyancy and nozzle spray pattern on the heater temperature spread are investigated. The characterization of the oil pump and the operating cycle and temperature spread tests are proposed for further evaluation of the engine.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 5843, 5846, 5847, 5848, 5849, 5850

3307 Emission Control

REFER ALSO TO CITATION(S) 6433

5978 **(DTH-LET-RE—87-2) Emissions from older cars.** Schramm, J.; Sorenson, S.C. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). 1987. 99p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750376/JAW.

The results of a literature review on the subject emission of CO, HC, and NO/sub X/ from used cars is presented. The object of the review is to a) elucidate those engine parameters related to emission that change during the lifetime of a car; b) illustrate the emission relationships for used cars during different driving patterns; c) relate the results of the reviews to efforts of introducing exhaust gas emission control for used cars. (LN). EFP-85, 26 refs.

3308 Alternative Fuels

5979 **(AD-A—184028/9/XAB) Models for conducting economic analysis of alternative-fuel vehicles. Master's thesis.** Grenier, D.R. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1987. 75p. NTIS, PC A04/MF A01.

The present status of alternative-fuel vehicles, specifically electric-powered and compressed natural gas-powered vehicles is summarized. Specific advantages and disadvantages of each vehicle type, in comparison to the gasoline-powered vehicle, are reviewed. A life-cycle-cost model is formulated for each vehicle type. An integer linear program is derived and explained as a means of determining the optimal mix of vehicles for a command's transportation fleet. The models are tested by running several test cases using data from the Naval Postgraduate School transportation office.

5980 **(DTH-LET-RE—87-1) Natural gas in a D.I. diesel engine. A comparison of two different ways.** Jun-ming, Qu; Sorenson, S.C.; Kofoed, E. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750380/JAW.

A D.I. diesel engine was modified for natural gas operation with pilot injection and with spark ignition so that a comparative analysis of these two different ways of using natural gas could be made. The results of the experiments indicate that for a diesel engine, it is possible that the operating characteristics of a straight natural gas engine are comparable with those of a diesel/gas engine at the same compression ratio and speed. For a dual fuel engine with pilot injection the best diesel/gas ratio by energy content is approximately 20/80 at full load operation. For straight natural gas engine with spark ignition, quality governed natural gas operation has good efficiency but poor NOx emissions. This problem could be improved through throttle controlled operation. These two different ways of using natural gas are best suited to stationary engines.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 6400

5981 **(AD-A—184313/5/XAB) Maritime strategy and coalition defense: a synthesis for NATO (North Atlantic Treaty Organization) success.** Glazier, D.W. (Naval War Coll., Newport, RI (USA)). 1987. 18p. NTIS, PC A02/MF A01.

Maritime strategy is an essential element underpinning the credibility of the NATO alliance. Far from hampering continental defense, the strategy enhances the deterrent posture and, should deterrence fail, increases the prospects for both preserving NATO allies and for ending hostilities on favorable terms. Execution of the global-war portion of the maritime strategy would almost certainly occur as part of a NATO defensive effort against Warsaw Pact aggression. Also, discussions about the feasibility of executing the maritime strategy have attempted to compare the us national force structure and capabilities to that of the Soviets.

5982 **(AD-A—184407/5/XAB) Arms control and the new revolution in Soviet military affairs. Professional paper.** FitzGerald, M.C. (Center for Naval Analyses, Alexandria, VA (USA). Naval Warfare Operations Div.). Aug 1987. 25p. (CNA-PP—460). NTIS, PC A02/MF A01.

According to Soviet military writers, the changes in doctrine that constitute the new revolution in Soviet military affairs were generated by evolving technological developments in both nuclear and conventional arms. A review of Soviet military literature in the 1980s, moreover, provides evidence that changes in strategy, operational art, and tactics have in turn generated changes in force structure and weapons modernization that indicate a downgrading of nuclear contingencies and a preference for conventional warfare. Especially in light of Gorbachev's repeated admissions that the present level of Soviet defense expenditures threatens to derail his internal re-structuring, the new revolution in Soviet military affairs implies a genuine Soviet incentive to pursue arms control agreements with the United States.

5983 **(PB—87-228649/XAB) C i faelt: foersoek med ett oevningsaemne foer c-stridsmedel (C in the field: experiments with a chemical warfare training agent).** Karlsson, E.; Burstroem, B.; Bylund, J.; Lindberg, G.; Marchner, H. (Foersvarets Forskningsanstalt, Umeaa (Sweden)). Apr 1987. 25p. (In Swedish). (FOA-C—40239-4.5). NTIS, PC E03/MF A01.

A chemical warfare training agent (ethyl benzoate) was disseminated from an aircraft in order to try a dissemination against civilians and measure the gas concentration and the personnel contamination. The training agent gives the same color on detector paper no. 102 as mustard gas. The volatility, however, is near the value for soman. The agent is rather expensive. The training agent worked well. As an ordor may remain for several hours, a contamination of civilian equipment has to be avoided. Therefore, dissemination from aircraft may cause problems. The concentration in the air decreased to small values after 2-3 hours, showing that most of the agents lying on the surface had evaporated. The contamination of personnel doing activities in the contaminated area also decreased greatly after some hours. However, weak evaporation occurred from the sorbed part of the agent for at least six hours after the dissemination. As the experiment was performed with a training agent, only preliminary conclusions can be made concerning real agents.

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 6399

3503 Verification

REFER ALSO TO CITATION(S) 6582

36 MATERIALS

REFER ALSO TO CITATION(S) 5379

5984 **(UCID—20622-87-3) Chemistry and Materials Science quarterly research report: Weapons-Supporting Research and Departmental Institutional Research and Development: Third quarter FY87.** (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002430/JAW.

This quarterly report describes progress in basic and applied research carried out in the Chemistry and Materials Science Department under the auspices of Weapons Supporting Research (referred to as Chemistry Research Resource, or CRR) and the departmental Institutional Research and Development program. These activities tend to have longer-term goals than those funded directly by Laboratory programs. The progress report has been divided into broad categories that reflect research areas of current emphasis in the department: advanced materials, materials characterization and analysis, physical metallurgy, chemical reactions and transport processes, properties of hydrogen isotopes, and advances in instrumentation.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 5566, 5714, 5714, 5718, 5720, 5720, 5721, 5721, 5722, 5722, 5723, 5723, 5724, 5724, 5725, 5725, 5726, 5726, 5727, 5727, 5728, 5728, 5729, 5729, 5730, 5730, 5731, 5731, 5732, 5732, 5733, 5733, 5734, 5734, 5735, 5735, 5736, 5736, 5737, 5737, 5738, 5738, 5739, 5739, 5740, 5740, 5741, 5741, 5742, 5742, 5743, 5743, 5744, 5744, 5745, 5745, 5746, 5747, 5747, 5748, 5748, 5749, 5749, 5750, 5750, 5752, 5753, 5753, 5803, 5809, 5809, 5810, 5810, 5949, 6060, 6088, 6185, 6232, 6236, 6274, 6278, 6279, 6380, 6424, 6917, 6919, 6920, 6921, 6934, 6938, 6939, 6939, 6940, 6940, 6941, 6941, 6942, 6942, 6943, 6944, 6945, 6946, 6947, 6948, 6949, 6949, 6950, 6951, 6952, 6952, 6953, 6953, 6954, 6954, 6955, 6956, 6957, 6961

5985 **(AD-A—184104/8/XAB) Topological aspects of infinite metal clusters and superconductors. Technical report.** King, R.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 11 Aug 1987. 23p. (TR—44). NTIS, PC A02/MF A01.

This paper summarizes the chemical-bonding topology of infinite metal clusters as well as superconductors constructed from metal octahedra or metal tetrahedra. The chemical-bonding topologies of discrete octahedral metal clusters can be either edge-localized (e.g., Mo 6x8L64+ derivatives), face-localized (e.g., Nb 6x12L62+ derivatives), or globally delocalized (e.g., Zr 6mu2-CL)12ECLn-12 derivatives where E=Be, B, C, N,). Infinite fusion of metal octahedra in one, two, and three dimensions leads to metal-cluster chains (e.g., Gd 2CI3), metal cluster sheets (e.g., Zr CL), and bulk metals, respectively. Superconductors exhibiting relatively high critical temperatures and magnetic fields are constructed from edge-localized metal polyhedra such as the Mo 6 octahedra in the ternary molybdenum chalcogenides (Chevrel phases) and Rh 4 tetrahedra in the ternary lanthanide rhodium borides leading naturally to the concept of porous delocalization in such materials.

5986 **(AD-A—184202/0/XAB) Gas tungsten-arc welding of Al-10Fe-5Ce. Final report, June 1983-June 1986.** Metzger, G.E. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). Feb 1987. 24p. (AFWAL-TR—87-4037). NTIS, PC A02/MF A01.

A thin sheet of the powder-metallurgy aluminum alloy A1-10Fe-5Ce was fusion welded with the gas tungsten-arc welding process. The effect of preweld vacuum heat treatment, filler metal, and the type of welding current was investigated. The gross porosity of welds made with untreated base metal was virtually eliminated by the use of a combination of preweld vacuum heat treatment and a direct-current electrode negative (DCEN) welding arc with helium shielding gas. The required heat treatment is estimated to be 20 hours at 750 F, which results in a reduction in the base-metal tensile strength from about 65 to 60 ksi. However, the presence of brittle phases near the weld interface causes low ductility and low strength. The tensile elongation at room temperature of longitudinal welds was about 1%, and the tensile strength joint efficiency of transverse welds was 55% when tested at room temperature, and 81% at a testing temperature of 600 F. Keywords: Gas tungsten arc welding, Aluminum alloy, Powder metallurgy, High temperature.

5987 **(CEA-DMECN-SRMA—86-1547) Effect of weak irradiation dose on resiliency characteristics of austenitic steels.** Tavassoli, A.A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). Nov 1986. 26p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750639/JAW.

For behavior study of static inner structure of fast neutron reactor, this report presents the influence of weak irradiation dose on the resiliency properties of 304L, 316L-SPH, 308L steels.

5988 **(CNEA—485) Electron microscopy of nuclear zirconium alloys. Report.** Versaci, R.A.; Ipohorski, Miguel. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina. Dept. de Materiales). (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1986. 107p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01 - Comision Nacional de Energia Atomica, Buenos Aires (AR). Order Number DE88700580/JAW.

Transmission electron microscopy observations of the microstructure of zirconium alloys used in fuel sheaths of nuclear power reactors are reported. Specimens were observed after different thermal and mechanical treatment, similar to those actually used during fabrication of the sheaths. Electron micrographs and electron diffraction patterns of second phase particles present in zircaloy-2 and zircaloy-4 were also obtained, as well as some characteristic parameters. Images of oxides and hydrides most commonly present in zirconium alloys are also shown. Finally, the structure of a Zr-2,5Nb alloy used in CANDU reactors pressure tubes, is observed by electron microscopy.

5989 **(CONF-860914—35) Critical fields and spin polarized tunneling measurements of very thin V_3Ga films.** Tkaczyk, J.E.; Tedrow, P.M. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). 1986. Contract FG02-84ER45094. 4p. NTIS, PC A02. Order Number DE87013864/JAW.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

The critical field of V_3Ga thin films has been measured with the field applied both perpendicular and parallel to the film surface. A transition from three to two dimensional behavior is noted as a function of thickness. Spin polarized tunneling measurements are presented for junctions fabricated with Al_2O_3 barriers and Fe counter electrodes onto 10 nm thick films of V_3Ga. Unexpectedly low values for the spin-orbit scattering rate and effective g-factor are inferred from the tunneling measurements. This result is shown consistent with critical field measurements. 14 refs., 4 figs.

5990 **(CONF-871126—5) Low temperature spin waves in amorphous Fe/sub 90-x/Ni/sub x/Zr_{10}.** Fernandez-Baca, J.A.; Lynn, J.W.; Rhyne, J.J.; Fish, G.E. (Oak Ridge National Lab., TN (USA); Maryland Univ., College Park (USA). Dept. of Physics; National Bureau of Standards, Washington, DC (USA). Inst. for Materials Science and Engineering; Allied-Signal, Inc., Morristown, NJ (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001752/JAW.

From 32. conference on magnetism and magnetic materials; Chicago, IL, USA (9 Nov 1987).

Inelastic neutron scattering measurements have been performed on rapid-quenched ribbons of Fe/sub 90-x/Ni/sub x/Zr_{10} (x = 1, 5, 10) to measure the small wave vector spin wave spectrum. At all three concentrations a quadratic dispersion relation typical of an isotropic ferromagnet is observed, but with anomalous properties at low temperatures. For x = 5 and 10 the excitations are found to broaden considerably for temperatures $\leq$0.3 T/sub c/. For x = 1 the spin waves not only broaden for T $\leq$0.5 T/sub c/, but the spin-wave energies decrease monotonically with decreasing temperature while a resolution-limited quasielastic component of the scattering develops. These results are consistent with a picture of competing ferromagnetic and antiferromagnetic interactions, with reentrant spin glass behavior evident if the frustration is sufficiently strong. 8 refs., 3 figs.

5991 **(CONF-8708154—1-Draft) X-ray measurements of phason distortion in ion-implanted Al-Mn.** Budai, J.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014566/JAW.

From International workshop on quasicrystals; Beijing, China (31 Aug 1987).

We describe an ion-implantation technique for producing thin layers of Al-Mn quasicrystal grains which are oriented over large areas ($\sim cm^2$). Exploiting this alignment, synchrotron x-ray diffraction measurements are obtained. The systematic distortions from perfect icosahedral symmetry are quantitatively explained in terms of a linear phason strain. The exact form of the phason strain for particular quasicrystal grains varies strongly with local growth conditions and appears to depend more directly on the interactions with the fcc matrix than with relaxations associated with the sample surface. 32 refs., 5 figs.

5992 **(CONF-8708161—1-Vugraphs) Basic energy sciences research in the Metals and Ceramics Division of Oak Ridge National Laboratory.** Bloom, E.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87013538/JAW.

From Materials Sciences Subcommittee of the Basic Energy Sciences Advisory Committee meeting; Argonne, IL, USA (6 Aug 1987).

The role of boron in Ni_3Al was investigated. Microalloying with boron improved the tensile ductility and suppressed brittle grain boundary fracture. When the Al content was increased from 24 to 25%, ductility decreased and fracture increased in alloys doped with 0.2% boron. Fracture and strain in Al_2O_3, near surface mechanical and physical properties, and microstructure of ion-implanted sapphire were also investigated. Increasing the toughness of the matrix of Al_2O_3 by whisker toughening with transformation toughening resulted in a product tougher than the toughening mechanisms. The hardness of amorphous Al_2O_3 was 20% of the crystalline value, while the elastic modulus was 40%.

5993 **(EGG-M—07986) Weldability of rapidly solidified Type 304 stainless steel.** Clark, D.E.; Einerson, C.J.; Loop, R.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 4p. (CONF-860594—13). NTIS, PC A02. Order Number DE88001603/JAW.

From ASM international trends in welding research meeting; Gatlinburg, TN, USA (18 May 1986).

The present investigation involves experimental and modeling work in welding processes considered potentially suitable for the joining of RSP materials. The material studied was stainless steel 304. The processes investigated experimentally in some detail include laser, capacitor discharge, inertia, and gas tungsten arc welding. Although the latter is clearly not a rapid solidification process, it was used as a well characterized standard for comparing the welding response of rapidly solidified materials with both conventional and other RSP materials. Modeling efforts were considered important to this study for correlation with the original RSP parameters. Such a correlation is required for determining the suitability of joining techniques. 6 refs., 3 figs., 1 tab.

5994 **(EGG-M—18186) A numerical thermal model of the rapid solidification parameters in the capacitor discharge welding process.** Einerson, C.J.; Clark, D.E.; Devletian, J.H. (EG and G Idaho, Inc., Idaho Falls (USA); Oregon Graduate Center, Beaverton (USA)). 1987. Contract AC07-76ID01570. 9p. (CONF-870307—24). NTIS, PC A02. Order Number DE88002206/JAW.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The capacitor discharge (CD) welding process is investigated as a means of joining materials produced by Rapid Solidification Processing (RSP). The rapidly solidified microstructures produced by this process are evaluated and compared with the microstructure of the original RSP materials and a one-dimensional finite element heat conduction model is used to evaluate cooling rates, solidification rates, and temperature gradients near the fusion line. 10 refs., 5 figs., 6 tabs.

5995 **(EGG-M—20387) Materials issues in cask development.** Chapman, R.L.; Sorensen, K.B. (EG and G Idaho, Inc., Idaho Falls (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC07-76ID01570. 9p. (CONF-8707115—1). NTIS, PC A02. Order Number DE87014876/JAW.

From Institute of nuclear management annual meeting; Northbrook, IL, USA (12 Jul 1987).

This paper identifies potential new materials as a function of their use in the cask. To the extent that identified materials are not yet qualified for their intended application, this paper identifies probable technical issues and development efforts that may be required to qualify the materials for use in transportation casks. 1 tab.

5996 **(EGG-M—26486) Summary of comparison between experimental and analytical (including empirical) results for initiation of crack growth for surface cracks.** Reuter, W.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 49p. (CONF-8611197—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001604/JAW.

From 3. national symposium on nonlinear fracture mechanics; New Orleans, LA, USA (3 Nov 1986).

Surface-cracked specimens are used to simulate the behavior of structures containing defects. For these ferritic steel specimens the test temperatures of 255 and 297 K corresponded to the the lower shelf and the lower region of the ductile-brittle transition curve, respectively. Therefore, the conditions tested ranged from elastic to elastic-plastic to fully plastic with only small changes in tensile properties but substantial changes in fracture toughness. This paper compares experimental results based on crack initiation for the surface-cracked specimens with predictions of J/sub Ic/ and on an empirical correlation using the flow stress. 15 refs., 11 figs., 5 tabs.

5997 **(GKSS—87/E/24) Mechanized TIG root welding with large gap width in hyperbaric environment.** Jansen, B. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R.. Inst. fuer Anlagentechnik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hochschule der Bundeswehr, Hamburg (Germany, F.R.). Fachbereich Maschinenbau; GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1987. 176p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750993/JAW.

Experiments with the mechanized welding of a root run have been carried out with the Tungsten-Inert-Gas welding process in hyperbaric gas atmosphere down to 500 m simulated water depth. A fundamental part describes the relationship between an increased pressure and the TIG-process. For welding a root run the parameter fields for the welding datas have been developed depending on pressure, root gap width and welding position. The experimental results for the relationship between root gap width and welding parameters are compared with theoretical suggestions. With 63 figs., 3 tabs..

5998 **(IAEA-R—3266-F) Mechanical properties and structure of Zircaloy attached by UO/sub 2+x/ and fission products. Final report for the period December 1982 - June 1987.** Holub, F. (Oesterreichisches Forschungszentrum Seibersdorf GmbH, Austria. Inst. fuer Werkstofftechnologie). (International Atomic Energy Agency, Vienna (Austria)). Aug 1987. 79p. (OEFZS-A—1032). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700605/JAW.

The aim of this project was to determine the combined long-term effect of simulated fission products and hyperstoichiometric uranium dioxide on the mechanical properties and structure of Zircaloy. Three groups of fission product elements or compounds were defined: The rare earth oxides CeO/sub 2/, La/sub 2/O/sub 3/, Nd/sub 2/O/sub 3/, Y/sub 2/O/sub 3/; The metals No, Ru, Ag; The low melting elements Te, Sb and Cd. Each of these groups of fission products was mixed with UO/sub 2+x/ in proportion related for burnups of 5, 10 and 30%. The simulated fuel mixtures were filled into tubular Zircaloy casings, plugged and welded. These specimens were annealed at 350, 500 and 700 deg. C up to 17,500 hours. The test results indicate different kinds of action of the simulated fuel constituents. Mixtures of rare earth oxides and UO/sub 2+x/ embrittle Zircaloy drastically at higher temperatures. There exists a mutual intensifying effect of rare earth oxides and UO/sub 2+x/. UO/sub 2+x/ and (Mo + Ru + Ag) and their mixtures act very similar on Zircaloy. The low melting fission products (Te + Sb + Cd) influence the ductility of Zircaloy in an advantageous manner, compared to pure UO/sub 2+x/ fuel. The layer of zirconium tellurides seems to protect the Zircaloy metal against the embrittling attack of oxygen from UO/sub 2+x/. The most important events of tensile tests at 400 deg. C are the high values of the elongation of specimens which are brittled at room temperature. It should guarantee the integrity of fuel elements, which have been attacked chemically by fission products at temperatures of 400 deg. C and higher. 10 refs, 165 figs, 6 tabs.

5999 **(INIS-mf—10736) Investigation of the magnetic after-effect in iron-alpha after neutron irradiation at low temperature.** Mensch, W. (Max-Planck-Institut fuer Metallforschung, Stuttgart, Germany, F.R.. Inst. fuer Sondermetalle/Metallkunde). (Stuttgart Univ. (Germany, F.R.). Fakultaet 12 - Physik; Max-Planck-Institut fuer Metallforschung, Stuttgart (Germany, F.R.). Inst. fuer Sondermetalle/Metallkunde). 18 Jul 1986. 211p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751011/JAW.

The present thesis investigates the magnetic after-effect for neutron irradiated, polycrystalline iron-alpha for the temperature range 10 to 400 K by means of susceptibility measurements. 24 maxima of magnetic after-effect are found, which are related to different classes of defects. (BHO).

6000 **(ITEF—36(1986)) Neutron diffraction study of Ti-Zr-Si amorphous alloys.** Smirnov, L.S.; Kovneristyj, Yu.K.; Nartova, T.T.; Tarasova, O.B.; Buzin, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700677/JAW.

Crystallization of binary and ternary amorphous alloys of Ti-Zr-Si system was investigated with the use of neutron diffraction analysis. Alloy samples were annealed at 160, 250, 580 and 660 deg C and then subjected to sudden quenching. Differences in crystallization of binary Ti-Si and ternary Ti-Zr-Si alloys were revealed. It is shown that a new ternary compound forms during crystallization of Ti-Zr-Si alloys. It was concluded that zirconium promotes amorphous phase formation. 21 refs.; 7 figs.; 5 tabs.

6001 **(LA—11084-MS) An overview of metal plasticity.** Preston, D.L. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001658/JAW.

This report mathematically describes plastic flow in metals. A review of single crystal and polycrystal plasticity is included to add comprehensiveness and to give the reader some physical understanding of plastic flow in commercially available metal. Because certain flow problems are best formulated in coordinate systems that reflect a basic symmetry in the flow, a derivation has included of the generally invariant thermoelastic-plastic flow equations, which are applied to the specific example of spherically symmetric flow. 44 refs., 4 figs.

6002 **(LA-UR—87-3574) An analysis of the effect of system variables on the quality of thin films and powders produced by laser-breakdown chemical vapor deposition.** Joyce, E.L. Jr.; Jervis, T.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871006—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001793/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

A gas phase process for large area depositions on an ambient temperature substrate using laser-induced dielectric breakdown of gas phase precursors has recently been developed. Deposits of nickel alloys show excellent grain refinement (<10 nm) and metastable phase incorporation due to rapid quenching from the gas phase. Particle size distribution and compositional variance within the deposited films have been studied using electron microscopy and electron diffraction. Kinetic expressions to explain homogeneous gas phase nucleation and growth of the deposited materials have been developed in an effort to better understand this process. The effect of system variables on film and powder grain sizes has been studied. This analysis gives insight into the fluid flow/heat transfer patterns involved in the system and their effect on the final deposited material. Heat transfer and fluid flow patterns must be optimized to minimize residence time in the gas phase to prevent excessive agglomeration of the fine particles. Results of the effect of system pressure, gas phase composition, laser pulse energy, and gas flow rate are presented as they effect particle size distribution within the deposition. 13 refs., 5 figs.

6003 **(LA-UR—87-3618) The microstructure and texture of torsion-reverse torsion experiments.** Rollett, A.D.; Lowe, T.; Kocks, U.F.; Stout, M.G. (Los Alamos National Lab., NM (USA); Sandia National Labs., Livermore, CA (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8709172—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001801/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Sep 1987).

Recent experiments with short thin-walled tubes (Lindholm design) tested in torsion and reverse torsion have confirmed both the persistence of a shear texture at zero net strain and the restoration of the grain shape. Calculations of theoretical texture development using a code based on the Bishop and Hill analysis have confirmed the reversibility of texture development when Taylor-based models are used. This code includes the effect or Relaxed Con-

straints and uses a nonlinear strain rate sensitivity to resolve the ambiguity of slip system choice. Calculations performed with the Asaro-Needleman code do leave a small residual texture at zero net strain. The conclusion is that there is sometimes an irreversible component of texture development that is not accounted for by the geometry of plastic deformation. 11 refs., 6 figs.

6004 **(LAFI—099) Temperature dependence calculations of static structure factors for liquid rubidium and cesium.** Nikolaev, V.O.; Iolin, E.M.; Skovorod'ko, S.N.; Fomin, V.A.; Shpil'rajn, Eh.Eh. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1986. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700740/JAW.

Calculations of the static structural factors (S(q)) of liquid rubidium and cesium from the precision density measurement data have been performed. The calculation results were used to obtain the temperature dependences of the first S(q) maximum positions exhibiting peculiarities similar to those observed in neutron diffraction studies of these metals. In accordance with calculations of radial ion distribution function there exist abrupt decreases of the first coordination sphere radii at the temperatures of density and structural factors anomalies. 29 refs.; 13 figs.

6005 **(LBL—23250) Fracture analysis of drawn composite dual-phase steel wire.** Sidjanin, L.; Miyasato, S.; Thomas, G. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 18p. (CONF-8710176—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001396/JAW.

From Interwire conference; Atlanta, GA, USA (25 Oct 1987).

The Fe/2 Si/0.1 dual-phase steel was studied with composition 0.08 C, 1.9 Si, 0.32 Mn, 0.004 P, 0.004 S (wt %) to develop the dual-phase structure with various morphologies. Thermal and control rolling thermomechanical processing were used. Treated samples were machined to 5.5 mm diameter and then drawn without coating in a hand operated drawing machine. The microstructures of longitudinal sections before and after deformation were assessed by light optical and scanning electron microscopy (SEM). Void density measurements were performed by SEM at 2000X. A linear relationship was found between true strain and void density after wire drawing low carbon duel-phase steels for all morphologies studied. Void formation was found to begin either by decohesion of the ferrite/martensite interface, or by shear microcracking of the martensite particles. The formation of voids during wire drawing can be correlated with differences in martensite morphology and martensite/ferrite interface coherency. A fibrous distribution of 20% lath martensite in fine-grained ferrite appears to be the most promising composite to obtain high strength ductile wire, e.g., for tire cord application and hence Fe/Si/C rather than Fe/Mn/C steels are preferred. 21 refs., 8 figs., 1 tab.

6006 **(LBL—23558) Atomic resolution imaging in Al-Li-Cu alloy.** Radmilovic, V.; Thomas, G. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 17p. (CONF-8706222—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002278/JAW.

From 4. international aluminum lithium conference; Paris, France (10 Jun 1987).

The structure of β'/δ' and T1 precipitates in Al-Li-Cu alloy has been investigated using the atomic resolution electron microscope and computer simulation. Thermal-mechanical processing was done in a program designed to define precipitate nucleation and growth conditions. Results show the β'/δ' complexes are misoriented $L1_2$ ordered particles. The δ' shell develops polygonal facets around β' core. The T1 phase density is considerably increased by mechanical processing between aging treatments and the results are consistent with increased heterogeneous nucleation, especially by slip within δ' particles. The structure of T1 is proposed to be hexagonal with different composition layers ABCDA, but which are faulted during growth. 28 refs., 12 figs.

6007 **(LBL—23881) Structure determination with HREELS [High-Resolution Electron Energy-Loss Spectroscopy] and LEED [Low-Energy Electron Diffraction]: The molecular structure of chemisorbed benzene on Pd(111).** Ohtani, H.; Bent, B.E.; Mate, C.M.; Van Hove, M.A.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 13p. (CONF-8708167—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002279/JAW.

From 4. international conference on solid films and surfaces; Hamamatsu, Japan (23 Aug 1987).

The combination of HREELS (High-Resolution Electron Energy-Loss Spectroscopy) and LEED (Low-Energy Electron Diffraction) has been successfully applied to study complicated coadsorption structures of benzene and CO on various transition metal surfaces (Pd, Rh, Pt). Through these studies, different benzene structures have emerged depending on the substrate metal. Recent work concerns coadsorption of benzene and CO on Pd(111), where an almost gas-phase like benzene structure has been detected. 22 refs., 3 figs., 1 tab.

6008 **(MLM—3456(OP)) Reduced thermal input by proper selection of YAG laser welding parameters.** Jones, W.H. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 4p. (CONF-8709178—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000730/JAW.

From International conference on applications of electron and laser beam welding; Hartford, CT, USA (16 Sep 1987).

This paper presents a case history to illustrate the importance of properly selected YAG laser welding parameters to control thermal input to temperature sensitive components. One of the assembly operations in the production of a small detonator is the attachment of a 304 stainless steel charge holder to the 304 stainless steel header body by laser welding. A high percentage of these assemblies were failing the final helium leak test. To locate production operations that tended to cause leakers, a comprehensive study was conducted on a lot of 333 detonators. The results of this study showed that the laser welding operation was causing a 23% leak reject rate. This assembly had been in production about four years with varying degrees of helium leak test problems. The original requirements for the circumferential weld was that it sealed the joint and held the components in relative position. When the parameters were developed in 1978, we knew much less about the laser welding process than in 1982 when this work was completed. Little concern had been given to the total heat input required to produce the weld. A study was initiated to determine how much thermal input could be reduced before weld integrity was affected.

6009 **(N—87-27029) Materials for advanced turbine engines (MATE). Project 4: erosion resistant compressor airfoil coating.** Rashid, J.M.; Freling, M.; Friedrich, L.A. (Pratt and Whitney Aircraft, East Hartford, CT (USA)). May 1987. 88p. (NASA-CR—179622; NAS—1.26:179622; PWA—5574-206). NTIS, PC A05/MF A01.

The ability of coatings to provide at least a 2X improvement in particulate erosion resistance for steel, nickel and titanium compressor airfoils was identified and demonstrated. Coating materials evaluated included plasma sprayed cobalt tungsten carbide, nickel carbide and diffusion applied chromium plus boron. Several processing parameters for plasma spray processing and diffusion coating were evaluated to identify coating systems having the most potential for providing airfoil erosion resistance. Based on laboratory results and analytical evaluations, selected coating systems were applied to gas turbine blades and evaluated for surface finish, burner rig erosion resistance and effect on high cycle fatigue strength. Based on these tests, the following coatings were recommended for engine testing: Gator-Gard plasma spray 88WC-12Co on titanium alloy airfoils, plasma spray 83WC-17Co on steel and nickel alloy airfoils, and Cr+B on nickel alloy airfoils.

6010 (N—87-28429) Anlysis of doping modulated superlattice structures. Final technical report, 1 June 1984-31 May 1985. Buoncristiani, A.M. (Christopher Newport Coll., Newport News, VA (USA)). May 1985. 29p. (NASA-CR—181257; NAS—1.26:181257). NTIS, PC A03/MF A01.

A new method of growing doping modulated superlattice structures is discussed. This method uses organo-metallic chemical vapor deposition (MO-CVD) with the added feature of controlled plasma in the growth regions. The main objective was to study how the growth environment affected the electronic and optical properties of the superlattice structures. Because a serious safety hazard was discovered in the growth process, no superlattice structures were fabricated and the research on this material had to be terminated. The hazard had to do with the lack of adequate means for the disposal of toxic elemental beryllium.

6011 (RFP—4098) Interrelation and measurement of formability, strengthening, and thermomechanical processing under metalworking conditions. Jackson, R.J.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 14 Sep 1987. Contract AC04-76DP03533. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002485/JAW.

A single test was developed that yields the formability, strengthenability, and thermomechanical processability of a material. The test was based on observations in coupon rolling that, once a base elasticity is exceeded, the material thickness reduction is linear with respect to roll gap reduction at all roll gap settings, and the log of the hardness is linear with respect to the material thickness or roll gap reduction. The first observation suggested measuring a plastic index, P (the slope), and an elastic index, E (the x-intercept), and combining both to obtain a formability index defined as $F^* = (P/E)0.1$. The second observation suggested measuring a hardening index, H (the slope), and a hardness index, I, (the initial hardness), and combining both to obtain a strengthenability index defined as $S^* = H/I$. Both indices are measured while the material is being thermomechanically processed through a wide range of tooling geometrics (gap clearances). This allows a measure of the ease with which the material can be formed and strengthened simultaneously, i.e., a measure of the thermomechanical processability, TMP*. This quantity was defined as $TMP^* = F^* \cdot S^*$. 25 refs., 20 figs., 6 tabs.

6012 Erosion of amorphous nickel—phosphorus. Goretta, K.C.; Routbort, J.L.; Mayer, A.; Schwarz, R.B. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Materials Research;* **2**: No. 6, 818-826(Nov 1987).

The steady-state erosion rate of electrodeposited amorphous $Ni_{80}P_{20}$ by angular alumina particles has been measured as a function of impingement angle from 15°—90°, particle velocity from 50—100 m/s, and average particle diameter from 40—390 μm. The erosion rate can be described by a power law in velocity and particle size. The erosion rates in $Ni_{80}P_{20}$ were compared to those measured for electrodeposited pure crystalline nickel. For all experimental conditions the erosion rate in the amorphous alloy exceeded that of nickel. The material removal in amorphous $Ni_{80}P_{20}$ is attributed to formation of plastic shear bands below the impact areas. For the most energetic particles the erosion leads to the formation of melt, which seems to be a consequence of the localized shear.

6013 Mixture of ordered domains in the NiAl(111) surface. Noonan, J.R.; Davis, H.L. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6024). *Physical Review Letters;* **59**: No. 15, 1714-1717(12 Oct 1987). Contract AC05-84OR21400.

The atomic structure of the NiAl(111) surface has been investigated through a LEED I-V analysis. In order to achieve a unique, consistent agreement between experimental and calculated I-V spectra, this surface is determined to be a 50-50 mixture of two ordered domains, one of which is Al terminated and the other is Ni terminated. The relaxations of the outermost interlayer spacings in each domain have been determined as well, and they are different for the two domains. The NiAl(111) surface is the first reported example of a binary-alloy surface in which a mixture of ordered domains with differing terminations coexists.

6014 The influence of implanted yttrium on the mechanism of growth of Cr/sub 2/O/sub 3/ on Cr. Cotell, C.M.; Yurek, G.J.; Hussey, R.J.; Mitchell, D.F.; Graham, M.J. (H.H. Uhlig Corrosion Lab., Massachusetts Institute of Technology, Cambridge, MA 02139). *Journal of the Electrochemical Society;* **134**: No. 7, 1871-1872(Jul 1987).

One of the apparent effects of Y on the growth of Cr/sub 2/O/sub 3/ scales, based on inert marker studies, is a change in growth mechanism from predominant cation diffusion to predominant anion diffusion. The interpretation of inert marker studies has always been open to question, and a recent study of the mechanisms of growth of α-Al/sub 2/O/sub 3/ scales using /sup 18/O tracer techniques has demonstrated that the results of inert marker studies can be misleading. Results of /sup 18/O tracer oxidation experiments conducted with Y-implanted and Y-free Cr are reported in this paper, which demonstrate that Y implantation does change the mechanism of oxide growth.

6015 Thermal stability of rare-earth oxides in Ti when annealed above the α/β transus. Lofvander, J.P.A.; Court, S.A.; Kirchheim, R.; Fraser, H.L. (Dept. of Materials Science and Engineering, Univ. of Illinois, 1304 W. Green Street, Urbana, IL 61801). *Scripta Metallurgica;* **21**: No. 6, 859-862(Jun 1987).

In most cases the thermal stability has been demonstrated by restricting annealing to the temperature range corresponding to α-Ti. Since many Ti alloys make use of processing and heat-treatments when the matrix is β-Ti, it is of interest to determine the stability of these rare-earth oxides when annealed above the $\alpha\beta$ transus. The paper describes the results of annealing a Ti-0.7Er alloy which has been rapidly solidified and heat-treated subsequently so that it contains a refined dispersion of Er/sub 2/O/sub 3/. The alloy composition was chosen so that a slight excess of Er remains in the matrix following oxide formation. In this way, since Er is not known to be either an α- or β-Ti stabilizer, it has been assumed that the transus temperature is that of pure Ti, and the presence of a two-phase (α+β) field, such as would occur with an excess of oxygen is avoided. It has been shown that when a refined dispersion of rare earth oxides is annealed above the $\alpha\beta$ transus the average particle diameter coarsens from ≃50nm to ≃ 0.5μm. It is concluded that Ostwald ripening is effected mainly by enhanced diffusion along the migrating interphase boundaries during the transformation of α- to β-Ti.

6016 Direct aging of Aiota-1.7 at. % Cu between the reported GP zone solvi. Koo, Y.M.; Wall, M.E.; Tanner, L.E.; Cohen, J.B. (Dept. of Materials Science and Engineering, The Technological Institute, Northwestern Univ., Evanston, IL 60201). *Scripta Metallurgica;* **21**: No. 6, 817-820(Jun 1987).

From the evidence presented here and that of other authors the authors conclude that a true GP II solvus line does not exist and that the transition from GP I and GP II is simply a coarsening process. However, an alternative may exist. That is, we may be dealing with a phase selection process related to competitive heterogeneous and homogeneous nucleation kinetics that is highly composition dependent. In this case, for the alloy studied, here, the time-temperature "window" for GP II stability may be so restricted that it is not possible to reach conditions for critical nucleation (either homogeneous or heterogeneous) without being preempted by heterogeneous nucleation of Θ′ prime. Studies of Cu-Be alloys indicate that such stability "windows" expand as aging kinetics become more sluggish with decreasing solute. The change in kinetics is primarily due to decreases in driving force (i.e. decreases in critical undercooling) which scale with the solidus and each metastable transus. If this is the case, it may be possible to directly nucleate GP II in alloys of lower Cu content. This type of examination is currently in progress. The authors report their initial attempts to nucleate Θ″double prime as the first phase by quenching an Aiota-1.7 at % Cu alloy directly to a temperature predicted to be within its time/temperature domain, and describe the phase evolution during isothermal aging.

6017 **Cavitation at migrating boundaries during high temperature fatigue.** Raman, V. (IBM T.J. Watson Research Center, Yorktown Heights, NY 10598). *Scripta Metallurgica;* **21**: No. 6, 827-832(Jun 1987).

There is growing interest in the role of migrating boundaries during high temperature deformation. One area of current interest is the manner in which grain boundary migration can influence deformation and fracture at elevated temperatures. Much of the detailed treatments of intergranular cracking and cavitation during creep deformation have centered on effects occurring at stationary grain boundaries. The conventional idea represented in numerous publications is that grain boundary sliding plays an important role in intergranular fracture at elevated temperatures. The large stress concentrations developed at irregularities on grain boundaries are frequently cited as the principal reason for the easy generation of cracks and cavities. This article concludes that high temperature fatigue can cause significant migration and sliding in Al-3% Mg and Pb-2% Sn solid solution alloys, and that microcavitation and cracking takes place at the migrating boundaries in specimens tested at large strain amplitudes and low test frequencies. Cavities may be isolated within grains due to boundary migration.

6018 **Influence of lithium on the corrosion of aluminum.** Gui, J.; Devine, T.M. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Center for Advanced Materials, Lawrence Berkeley Lab., Berkeley, CA 94720). *Scripta Metallurgica;* **21**: No. 6, 853-858(Jun 1987). Contract AC03-76SF00098.

Aluminium alloy 6061-T6 forms a protective passive film when anodically polarized in 0.05M Li/sub 2/O/sub 3/ but not when anodically polarized in 0.05M Na/sub 2/CO/sub 3/ or 0.05M K/sub 2/CO/sub 3/. SIMS analysis indicates that the film formed in 0.05M Li/sub 2/CO/sub 3/ contains lithium suggesting that lithium ions are extracted from the solution and incorporated into the film. The protective nature of the film formed in 0.05M Li/sub 2/CO/sub 3/ is indicated by the factor of 20 decrease in the corrosion rate of the alloy, the ability of the film to form even in the presence of chloride ions and the high value of the pitting potential.

6019 **Brittle behavior of a two-phase Lennard-Jones solid.** Sieradzki, K.; Shukla, K. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY 11973). *Scripta Metallurgica;* **21**: No. 5, 697-700(May 1987). Contract AC02-76CH00016.

A crack in the homogeneous 2-D triangular Lennard-Jones (L-J) solid responds to external loading in a ductile manner by emitting dislocations and blunting. Previous work has demonstrated that this ductile behavior may be modified by coating the crack surfaces with a film having a different lattice parameter or elastic modulus with respect to the bulk L-J solid. In this work the authors report on the initial results of a study directed toward determining if coherent inclusions can sufficiently "harden" the near crack tip region in a manner so as to change the balance between dislocation emission and cleavage in this material. Others have shown that there is a delicate balance between crack tip dislocation emission and cleavage in this material. The most efficient form of hardening results from a coherent second phase with a lattice parameter larger than that of the bulk material. Elastically hard inclusions provided only a slight degree of hardening in comparison. Hard inclusions with a higher degree of inclusion matrix bonding may provide more efficient hardening in analogy with conventional hardening mechanisms in dispersed phase alloys.

6020 **Observation of diffuse streaks in Au-Fe alloys utilizing synchrotron radiation.** Marsh, C.; Polat, S.; Chen, H. (Dept. of Materials Science, Univ. of Illinois at Urbana-Champaign, 1304 W. Green Street, Urbana, IL 61801). *Scripta Metallurgica;* **21**: No. 5, 619-624(May 1987).

In order to fully understand the magnetic behavior of Au-Fe alloys, it is necessary to understand both the magnetic structure and the local atomic arrangements exhibited by them. For this alloy system any heat treatment involving quenching from the solid solution phase field will produce something other than a perfect binary solid solution for all but the lowest Fe concentrations. The goal of the present work was to determine the dimensions of the diffuse streaks by means of a quantitative x-ray diffraction technique using monochromatic synchrotron radiation. For a Au-18at.%Fe single crystal examined by a quantitative x-ray diffraction technique, the presence of diffuse streaks has been confirmed. The slightly higher intensities at the <1 1/2 O> special points are believed to be caused by the intersection of four linking streaks rather than to superlattice peaks. The diffuse intensity pattern can be explained by the model of platelets along {420} planes as originally proposed by Dartyge et al. The average size of the platelets is estimated to be 1.6 nm. Because of the abrupt ending of the diffuse streaks it is concluded that the platelets are at least two atomic layers thick. The results for a Au-10.7at.%Fe single crystal are less clear.

6021 **Disclinations: Their relation to the anisotropies of rare-earth hard magnets.** Melamud, M.; Bennett, L.H.; Watson, R.E. (National Bureau of Standards, Gaithersburg, MD 20899). *Scripta Metallurgica;* **21**: No. 4, 573-576(Apr 1987).

In this work the authors observe that the major ligand lines, as seen at rare earth sites, correlate with experimental rare earth anisotropies. Previously their presence at 3d sites in hard magnets was observed to correlate with the occurrence of large 3d moments. The former arises from bonding and charge effects while the latter is, presumably, associated with interatomic exchange and the site volumes attending the presence of such ligand lines. These observations have allowed predictions to be made concerning the magnetic anisotropies which should arise in four crystal structures. These structures should provide environments appropriate to good hard magnets providing that they can be made to accommodate the necessary combinations of rare earth and 3d elements. More importantly, the authors have observed that there are different classes of major ligand lines with those involving only rare-earth ions tending to dominate, thus controlling the rare-earth site crystal field orientations. In those structures not having such lines, the major ligand lines involving mixes of rare earth and 3d atoms win by default and determine the orientations.

6022 **Lattice imaging study of grain boundaries at normal incidence to the boundary plane.** Mader, W.; Necker, G.; Babcock, S.E.; Balluffi, R.W. (Max Planck Institut fur Metallforschung, Seestrasse 92, 7000 Stuttgart 1). *Scripta Metallurgica;* **21**: No. 4, 555-560(Apr 1987).

The electron microscope lattice imaging technique has been widely used to study the atomistic structure of tilt grain boundaries. In these studies, the incident electron beam is aligned essentially parallel to the boundary tilt axis (i.e., the beam is parallel to the boundary). A projected image of the atomic columns which run parallel to the tilt axis in the grain boundary core region and the two adjoining crystals (Crystals 1 and 2) is then obtained on a plane perpendicular to the incident beam. Important information about the projected atomic structure of the core region and of the translational state assumed by Crystals 1 and 2 relative to one another in the plane of projection can be obtained from such an image. The paper describes work in which information about the translational state of a boundary is obtained by the lattice imaging technique under conditions where the incident beam is aligned perpendicular to the boundary plane. In this case, the image consists of a superposition of the projections on the boundary plane of the atomic columns in Crystals 1 and 2 which run perpendicular to the boundary. The boundary is the [001] Σ5 twist boundary in gold.

6023 **On the selectivity of certain experiments on diffusion induced grain boundary migration.** King, A.H. (Dept. of Materials Science and Engineering, State Univ. of New York at Stony Brook, Stony Brook, NY 11794-2275). *Scripta Metallurgica;* **21**: No. 4, 541-542(Apr 1987).

In recent months some papers have appeared in the literature describing systematic studies of diffusion induced grain boundary migration (DIGM) or related phenomena such as liquid film migration (LFM). The results appear to lend support to different theories regarding the origins of the DIGM phenomenon. This note explores the nature of this dichotomy and suggests how the apparently conflicting results can be reconciled.

6024 Simple operational approach to the analysis of creep and structural relaxations in an amorphous alloy. Di Melfi, R.J. (Materials Engineering Research and Development, 3444 Ullman St., San Diego, CA 92106). *Scripta Metallurgica;* **21**: No. 4, 421-426(Apr 1987).

In this work the authors provide the development of a simplified constitutive model for plastic deformation in metallic glasses that ca be easily employed in a general treatment of complex loading of amorphous films on crystalline substrates. The authors evaluate some of the existing more fundamental models for deformation in bulk amorphous samples based on their success at describing observed behavior and their adherence to fundamental physical principles. They then incorporate the essence of these models within a framework to form a simple phenomenology that still satisfies the above criteria. It is show that the simple result satisfactorily describes existing data. By analogy with crystalline solids, the basis of mechanistic models for plastic flow in amorphous metals involves the motion of a structural defect that either exists in the as-formed material or is produced under stress.

6025 (CE-Trans—8272) Investigating the serviceability of weld joints in pipes made from 12Cr1MoV steel with a view to dispensing with heat treatment. Khromchenko, F.A.; Venderova, L.D. (Central Electricity Generating Board, London (UK)). 1987. Translated from Metals in Modern Power Generating Plants, Energia (Moscow, USSR), 72-80(1977. (BLL-CEGB—9022.09). 28p. Issuing Activity.

Investigations were conducted into the stability of the structure and properties in the process of aging, and also in the brittle, long term and cyclic strength of weld joints in pipes with a diameter of less than 200 mm and a wall thickness of up to 20 mm made from 12Cr1MoV steel with seams comprising 10CrMo, 10CrMoV, Cr15Ni25Mo6 and Cr25Ni60Mo10 type compositions. It was found that the initial period of aging is the most dangerous and that it is characterized by increased sensitivity to brittle failure of weld joints with 10CrMoV and 10CrMo pearlitic weld metal. It is shown that heat treatment on high temperature tempering of weld joints with 10CrMoV weld metal is a necessary and obligatory technological operation, ensuring the required serviceability of a steam line. Confirmation was found regarding the assumption that the weak spot in weld joints comprising dissimilar steels is the fusion zone, in which brittle failure develops. It was found that non-heat treated weld joints with 10CrMo pearlitic weld metal without vanadium comply with requirements regarding brittle, long term and cyclic strength.

6026 Effects of boundary conditions on the flow and heat transfer in a rotating disk chemical vapor deposition reactor. Evans, G.; Grei, R. (Sandia National Labs., Livermore, CA 94550). *Numerical Heat Transfer;* **12**: No. 2, 243-252(1987).

Numerical solutions of the Navier-Stokes and energy equations have been obtained to predict the fluid flow, temperature profiles, and heat transfer in a rotating disk reactor. The effects of buoyancy, variable properties, and finite geometry have been included for helium. It is shown that recirculation of the gas can be reduced or eliminated by increasing the uniform velocity at the inlet of the reactor above the asymptotic value for a one-dimensional, variable-properties, infinite rotating disk. This is true for both adiabatic and isothermal reactor walls. Furthermore, a cooled reactor wall as opposed to an adiabatic reactor wall is shown to result in dramatically altered velocity and temperature fields and reduced recirculation of the gas. When recirculation of the gas is reduced or eliminated the disk heat transfer that results is highly uniform and in good agreement with the one-dimensional, variable-properties, infinite rotating disk result. These results are useful for the design and operation of rotating disk reactors for chemical vapor deposition since in many cases the uniformity of the deposit is highly dependent on the uniformity of the heat transfer.

6027 Internal hydrogen degradation of fatigue thresholds in HSLA steel. Esaklul, K.A.; Gerberich, W.W. (Al-Fateh Univ., Tripoli). pp 131-148 of Fracture mechanics: Sixteenth symposium. Kanninen, M.F.; Hopper, A.T. Philadelphia, PA; ASTM (1985). (CONF-830820—).

From 16. national symposium on fracture mechanics; Columbus, OH, USA (15 Aug 1983).

The presence of internal hydrogen through cathodic charging has substantial influence on the near-threshold fatigue behavior of an HSLA steel with an as-received yield strength of 365 MPa. The results of fatigue crack propagation tests in both as-received and heat-treated conditions indicate higher crack propagation rates and lower threshold stress intensities in the presence of internal hydrogen. These effects are dependent on strength, mean stress or R-ratio, and test temperature. The enhancement in the crack propagation process is more severe in the higher strength material and at higher mean stress. An unusual behavior was observed due to decreasing test temperature from 300 to 123 K in which higher thresholds and lower crack propagation rates at 233 and 173 K were obtained in the presence of internal hydrogen. These effects are a result of true intrinsic hydrogen enhanced fracture and deformation processes.

6028 Fracture toughness improvement in a carbon steel due to normalization. Macdonald, B.D. (Knolls Atomic Power Lab., General Electric Co., Schenectady, NY 12301). pp 238-250 of Fracture mechanics: Sixteenth symposium. Kanninen, M.F.; Hopper, A.T. Philadelphia, PA; ASTM (1985). (CONF-830820—).

From 16. national symposium on fracture mechanics; Columbus, OH, USA (15 Aug 1983).

Quantification of the fracture toughness improvement in a carbon steel due to normalization was investigated using A516-70 (normalized) and A36 (as-rolled) specimens tested at -40 and -46°C, respectively. The A516-70 was in its Charpy transition range and the A36 was on its Charpy lower shelf. This precluded fracture toughness comparison based on ductile tearing. Plasticity considerations excluded the plane strain fracture toughness idealization, and variations in specimen thickness disallowed use of the crack-opening-displacement method. The fracture toughness of the normalized steel was 2 1/4 times that of the as-rolled steel. The 3DFE analysis of the plastic stationary crack indicated, for the tougher A516-70, crack profile blunting and curvature reversal. Through-thickness FE mesh refinement revealed a local maximum value of plastic stress singularity strength removed from the plate midthickness, which confirmed observations made by P.S. Theocaris using the method of caustics. The fracture toughness of A516-70 was predicted reasonably well by a Charpy transition toughness correlation. As expected, the transition regime fracture toughness of the A36 steel was not predictable from its Charpy lower shelf energy.

6029 Fracture toughness testing of ductile cast irons. Van Den Avyle, J.A.; Lutz, T.J.; Bradley, W.L. (Sandia National Labs., Albuquerque, NM 87185). pp 328-346 of Fracture mechanics: Sixteenth symposium. Kanninen, M.F.; Hopper, A.T. Philadelphia, PA; ASTM (1985). (CONF-830820—).

From 16. national symposium on fracture mechanics; Columbus, OH, USA (15 Aug 1983).

The fracture toughness of ferritic, spheroidal graphite ductile cast iron has been measured by a single-specimen J-integral technique. The method used a servo-hydraulic test frame in the displacement control mode, with overall test control and data acquisition managed by a minicomputer. Digitized load and displacement values were combined to calculate incremental crack lengths based on measured crack length-compliance calibrations. Plots of J versus change in crack length were generated, and values of J/sub Ic/(and equivalent K/sub Ic/) were determined using ASTM Test for J/sub Ic/, a Measure of Fracture Toughness (E 813). This technique thus provided a means of determining the plane-strain fracture toughness (K/sub Ic/) using small samples (2.5 cm thick) at temperature from -150 to +25°C). Two ductile cast irons were investigated that had similar volume fractions of graphite, graphite nodule sizes, and ferrite grain sizes, but one contained approximately 15% peralite, while the other had less than 1% pearlite. The alloy with greater pearlite content exhibited higher strength and higher ductile-to-brittle transition temperature.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 5597, 5597, 5877, 5992, 6023, 6026, 6088, 6188, 6964

6030 (AD-A—184356/4/XAB) Effect of time and temperature on transformation-toughened zirconias. Final report. Schioler, L.J. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Jun 1987. 107p. (MTL-TR—87-29). NTIS, PC A06/MF A01.

The effects of exposure to elevated temperatures (900 to 1300 C) for times ranging from 50 to 500 hours on toughened oxide ceramics intended for use in heat engines were examined. The materials were magnesia-stabilized transformation-toughened zirconia, yttria-stabilized tetragonal zirconia polycrystal, and zirconia-toughened alumina, as well as untoughened zirconias for comparison. The materials were heat treated, and physical and mechanical properties were then measured at room temperature. High-temperature mechanical tests performed were stress rupture and stepped temperature stress rupture. The results of the tests indicate that the mechanical properties of magnesia-stabilized transformation-toughened zirconia degrade substantially after relatively short times at the moderate temperatures expected in low-heat-rejection diesel engines. The yttria-stabilized tetragonal zirconia polycrystal and the untoughened partially stabilized zirconia materials appear to be more stable against the effects of time and temperature.

6031 (BNL—40333) Photon stimulated desorption from oxidized Al(110). Johnson, E.D.; Garrett, R.F.; Knotek, M.L.; Sette, F. (Brookhaven National Lab., Upton, NY (USA); AT and T Bell Labs., Murray Hill, NJ (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-8705194—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002209/JAW.

From 3. international workshop on desorption induced by electronic transitions; Shelter Island, NY, USA (20 May 1987).

We have studied oxide films on Al(110) by photon stimulated desorption (PSD) on the Bell Labs U4 PGM at the National Synchrotron Light Source. Utilizing a time of flight technique we have obtained ion energy distribution (IED) and relative ion yield (RIY) data at the Al 2p and O 1s edges for oxides prepared at various temperatures. These initial studies suggest that different sites for the surface hydroxyls exist, that they can be selectively prepared, and examined by PSD. 15 refs., 9 figs.

6032 (CONF-851125—21) Mechanisms of material removal and damage penetration during single point grinding of ceramics. Kirchner, M.P.; Conway, J.C. Jr. (Ceramic Finishing Co., State College, PA (USA); Pennsylvania State Univ., University Park (USA). Dept. of Engineering Science and Mechanics). 1985. Contract AC01-83ER80015. 9p. NTIS, PC A02. Order Number DE88002212/JAW.

From American Society of Mechanical Engineers winter annual meeting; Miami, FL, USA (17 Nov 1985).

Contact fracture mechanics was used to investigate material removal and damage penetration during grinding of ceramics. Grinding is a complex process in which the abrasive impacts the surface and is driven along an arc-like path until the contact ceases. The contact forces cause a series of events that may include crushing, plastic flow, elastic recovery, generation of residual stresses, radial cracking, lateral cracking, chipping and strength degradation. At low contact loads and in some kinds of materials, not all of these events will occur. Analytical methods were used to investigate several of these events. These results were compared with the results of single point grinding experiments. 27 refs., 9 figs.

6033 (CONF-8704228—1) Magneto-optical studies of novel epitaxial films. Bader, S.D.; Moog, E.R. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. Order Number DE87011408/JAW.

From International symposium on magneto-optics; Kyoto, Japan (20 Apr 1987).

The magneto-optic Kerr-effect technique is used to explore the magnetic properties of ultra-thin epitaxial films of iron and chromium grown on (100) faces of gold and copper. The studies extend into the monolayer range, and are performed in the ultra-high-vacuum environment in which the films are grown. Auxiliary low-energy electron diffraction and Auger electron spectroscopy studies are used to characterize the epitaxy and growth-mode behavior. Highlights include: (a) an observed lowering of the Curie temperature, compared to that of the bulk, for monolayer-range from grown epitaxially on the lattice-matched (100) face of gold; (b) correlations between magnetism and morphology; (c) a search for the predicted ferromagnetism of chromium monolayers; and (d) the observation of a new, metastable surface magnetic state for the high-temperature, face-centered-cubic phase of iron, which is stabilized via epitaxy on the (100) face of copper. The opportunities, challenges and limitations posed by the present magneto-optical approach in assessing the properties of these atomically-engineered materials will be evaluated. 32 refs., 6 figs.

6034 (CONF-8707125—1-Vugraphs) Discussion of radiation effects and high-temperature oxide superconductors. Christen, D.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001427/JAW.

From Division of Materials Sciences contractors meeting; Oak Ridge, TN, USA (30 Jul 1987).

Physical radiation effects on high temperature superconductors La/sub 1.85/Sr/sub 0.15/CuO_4 and $YBa_2Cu_3O_7$ are presented. The importance of, and evidence for 2D superconductivity is also addressed. Most of this document are viewgraphs.

6035 (CONF-8708134—3) Effects of adsorption of polyacrylic acid on the stability of α-Al_2O_3, m-ZrO_2, and their binary suspension systems. Bleier, A.; Westmoreland, C.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002295/JAW.

From 18. annual meeting of the Fine Particle Society; Boston, MA, USA (3 Aug 1987).

The influence of polyacrylic acid having a molecular weight of 90,000 on the stability of aqueous suspensions containing either α-A_2O_3, monoclinic-ZrO_2, or both oxides was systematically studied over the range pH 3 to 11 using sedimentation, rheological, electrophoretic, adsorption, and pychometric methods. The anionic polymer adsorbs on each type of surface, with the corresponding isotherms appearing Langmuirian. Acid-base phenomena giving rise to charging of the oxide particulate surfaces and the polymer appear ultimately responsible for adsorption and overall stability behavior. 17 refs., 17 figs., 2 tabs.

6036 (DOE/ER/45180—T1) Grain boundary and surface diffusion in oxides: Progress report, August 15, 1986-October 1, 1987. Stubican, V.S. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). 1 Oct 1987. Contract FG02-85ER45180. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002348/JAW.

Diffusion of Co-57 in the surface layer of the (110) plane of single crystal NiO was studied. The Arrhenius plot for the surface diffusion shows no break in the temperature range 770 to 1200°C. An intrinsic vacancy mechanism is proposed. The first quantitative comparison between surface, grain boundary and volume diffusion for an ionic material was made. The surface diffusion coefficient for Co-57 is 1 to 2 orders of magnitude greater than the grain boundary diffusion coefficient and 5 to 7 orders of magnitude greater than the bulk coefficient. Activation energies for the surface, grain boundary and lattice diffusion of Co-57 in NiO are 139, 179 and 230 kJ/mole respectively. Study of the influence of point defects (vacancies and interstitials) on the surface diffusion is now in progress. Surface diffusion of Co-57 on the (110) plane of Fe_3O_4 and the (100) plane of NiO is being studied at 750°C under various oxygen pressures. Results obtained show the strong influence of cation vacancies on the surface diffusion in Fe_3O_4. 4 figs.

6037 **(DP-MS—87-33) Precipitation in alumina-rich spinel: A transformation-toughened ceramic single crystal.** Jantzen, C.M.; Herman, H. (Savannah River Lab., Aiken, SC (USA); State Univ. of New York, Stony Brook (USA). Dept. of Materials Science). Jul 1987. Contract AC09-76SR00001. 59p. (CONF-810528—19; CONF-850536—14). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87012380/JAW.

From 83. American Ceramic Society symposium on nucleation and crystallization in glasses; Washington, DC, USA (3 May 1981).

The transformation of single crystal spinel supersaturated with alumina to stable α-Al_2O_3 occurs sequentially. Four metastable phases were identified in six unique phase assemblages. The appearance of a more stable decomposition product caused the reversion (dissolution) of its immediate precursor. The two early transient precipitates, I/sub P/ and II/sub P/, were identified as solute rich GP zones aligned along the same crystallographic orientations as the sequentially formed intermediate transition phases, I/sub T/ and II/sub T/. The activation energies for precipitation and reversion were measured to be ~80 kJ, comparable to activation energies for precipitate strengthening in other ceramic and metallic systems. The phase assemblages are represented in the context of a time-temperature-extent of transformation (TTT) diagram compiled from the work of four independent studies. The phase transformations delineated by the c-shaped rate curves on the TTT diagram are shown to correlate with measured changes in mechanical properties. 58 refs., 12 figs., 2 tabs.

6038 **(EGG-M—05986) Oxynitride glass braze interactions in silicon nitride joining.** Tallman, R.L.; Coon, D.N.; Mittl, J.C.; Neilson, R.M. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1986. Contract AC07-76ID01570. 36p. (CONF-860418—27). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001600/JAW.

From 88. annual meeting of the American Ceramic Society; Chicago, IL, USA (27 Apr 1986).

This report emphasized the development of basic information relevant to the joining of silicon nitride ceramics. Joining techniques were devised using oxynitride glasses as brazes. Information on the adsorption of Y-Si-Al-O-N glasses is presented, along with other information on joining phenomena, mechanisms and joint structures. 6 refs., 12 figs., 4 tabs.

6039 **(EUR—10858) Assessment of the thermodynamic properties of uranium nitride, plutonium nitride and uranium-plutonium mixed nitride.** Matsui, T.; Ohse, R.W. (Commission of the European Communities, Karlsruhe (Germany, F.R.). European Inst. for Transuranium Elements; Commission of the European Communities, Luxembourg). 1986. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750622/JAW.

Thermodynamic properties such as vapour pressures, heat capacities and enthalpies of formation for UN(s), PuN(s) and (U, Pu)N(s) are critically evaluated. The equations of the vapour pressures and the heat capacities for the three nitrides are assessed. Thermal functions, and thermodynamic functions for the formation of UN(s), PuN(s) and (U, Pu)N(s), are calculated.

6040 **(LBL—24030) Hydrogen retention and release from uranium dioxide.** Sherman, D.F. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88002042/JAW.

The ceramic samples (UO_2) are exposed to high pressure hydrogen gas at a fixed temperature for a time sufficient to achieve equilibrium. After rapid quenching, the hydrogen-saturated sample is transferred to a vacuum-outgassing furnace. The sample is outgassed in a linear temperature ramp and the released hydrogen is detected by an in-situ mass spectrometer. This technique measures the rate of release of hydrogen with a sensitivity level of about 2 ng of hydrogen (as D_2) per hour. In this study, experiments were conducted on both polycrystalline and single-crystal UO_2. Experimental variables included temperature (1000 to 1600°C) and infusion pressure (5 to 32 atm D_2), and for the polycrystalline specimen, stoichiometry. Dissolution of H_2 in both single-crystal and polycrystalline UO_2 was found to obey Seivert's law. The Sievert's law constant of deuterium in single-crystal UO_2 was determined to be: $3.0 \times 10^7 \exp(-235\ kJ/RT)$ ppM atomic/$\sqrt{}$atm and for polycrystalline UO_2: $5.5 \times 10^4 \exp(-100\ kJ/RT)$ ppM atomic/$\sqrt{}$atm. The solubility of hydrogen in hypostoichiometric urania was found to be up to three orders of magnitude greater than in stoichiometric UO_2 depending on the O/U ratios, implying the anion vacancy is the primary solution site in the UO_2 lattice. The release-rate curves for the single crystal and polycrystalline UO_2 specimens exhibited multiple peaks, with most of the deuterium released between 600 and 1200°C for the polycrystalline samples, and between 700 and 1800°C in the single-crystal specimens. This release of hydrogen from UO_2 could not be adequately modeled as diffusion or diffusion with trapping and resolution. It was determined that release was governed by release from traps in both the polycrystalline and single crystal UO_2 specimens. 40 refs., 72 figs., 6 tabs.

6041 **(N—87-27008) Bridgman crystal growth.** Carlson, F.M. (Clarkson Univ., Potsdam, NY (USA)). Feb 1987. 12p. (NASA-CR—180958; NAS—1.26:180958). NTIS, PC A02/MF A01.

The primary focus was on completing a simulation of thermosolutal convection. The configuration employed was based on some MIT experiments using a germanium-silicon charge in a quartz ampoule with an aspect ratio of 8 and a rather large adiabatic zone. Two thermally stable cases were investigated: solutally unstable and solutally stable. Both use the same equilibrium phase diagram and thermophysical properties except the sign of the solutal coefficient of volume expansion is reversed. The results are discussed.

6042 **(NAGRA-NTB—87-09) Subcritical crack growth in high-grade alumina for container applications.** Fett, T.; Hartlieb, W.; Keller, K.; Munz, D. (9202069DE; Karlsruhe Univ., T.H., Germany, F.R.; 9202069DE; Karlsruhe Univ., T.H., Germany, F.R.. Inst. fuer Zuverlaessigkeit und Schadenskunde im Maschinenbau). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Sep 1987. 18p. Nagra, CH-5401 Baden, Switzerland.

The subcritical crack growth of a high-grade, 99.9% alumina ceramic in a concentrated salt solution at 70 C was investigated by lifetime measurements in static bending tests. For crack growth velocities lower than 10/sup -8/ m/s, the crack growth velocity - stress intensity factor relationship was found to be a power law with an exponent in the order of 50. The material had an inert bending strength close to 400 MPa. These values of the material parameters qualify the alumina investigated for high-level waste container applications from the point of view of subcritical crack growth.

6043 **(SAND—87-1308C) Contrast between the chemical, structural and electronic properties of thin films of Cu and Ni on the Ru(0001) surface.** Houston, J.E.; Berlowitz, P.J.; White, J.M.; Goodman, D.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-871125—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002360/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

Studies of the structural and electronic properties of thin Cu films on the Ru(0001) surface have revealed features which mirror the unique chemical behavior found for this bimetallic system. The interesting chemical behavior occurs in the submonolayer and ML regime where low-energy electron diffraction (LEED) studies have showed that Cu adopts a pseudomorphic structure, implying that the overlayer is under a 6% strain. Photoemission studies have shown electronic properties for the pseudomorphic layer unlike those found for either bulk Ru(0001) or Cu(111). We expanded the Cu/Ru(0001) work to include a comparison with the Ni/Ru(0001) bimetallic system. We compared the results of LEED, angle-resolved photoemission, thermal-programmed desorption and work-function measurements. 7 refs., 1 fig.

6044 **(SAND—87-2498C) Effect of high pressure oxygen loading on the superconductivity of La_2CuO_4.** Schirber, J.E.; Kwak, J.F.; Venturini, E.L.; Morosin, B.; Ginley, D.S.; Fu, W.S.; Baughman, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870873—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002108/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

This report shows that high-pressure oxygen treatment can increase the amount of superconducting material in La_2CuO_4 to over the one percent level (to date). The observed superconducting fraction suggests that the superconductivity is a bulk, rather than intergrain, phenomenon. Since no alkaline earth substitution for La is involved, this would imply that arguments based on substituent ion size are incorrect. 2 refs., 1 fig., 1 tab.

6045 **Field ion microscopy and imaging atom-probe mass spectroscopy of superconducting $YBa_2Cu_3O_7$/sub -//sub x/.** Kellogg, G.L.; Brenner, S.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 22, 1851-1853(30 Nov 1987). Contract AC04-76DP00789.

The structure and composition of the superconducting oxide YBa_2Cu_3O/sub 7-//sub x/ have been examined in atomic detail by field ion microscopy and imaging atom-probe mass spectroscopy. The field ion samples were prepared from hot-pressed disks of the oxide powders. Atomic resolution images were obtained with either argon or hydrogen as the imaging gas. Individual layers of atoms were observed which could be field evaporated in a uniform, layer-by-layer manner. Imaging atom-probe analysis of the field ion tips indicated a metal composition which varied noticeably from sample to sample and an oxygen concentration which was consistently much too low.

6046 **Observation of the magnetic field dependence of the cyclotron mass in the Kondo lattice CeB_6.** Joss, W.; van Ruitenbeek, J.M.; Crabtree, G.W.; Tholence, J.L.; van Deursen, A.P.J.; Fisk, Z. (Max-Planck-Institut fuer Festkoerperforschung, Hochfeld-Magnetlabor, 38042 Grenoble Cedex, France). *Physical Review Letters;* **59**: No. 14, 1609-1612(5 Oct 1987).

Low-temperature, high-field deHaas—van Alphen measurements are presented which show that the conduction-electron mass in the Kondo lattice CeB_6 decreases strongly with field. This field dependence is consistent with recent specific-heat results. The geometry of the Fermi surface does not depend on field. Thus we observe a reduction in the many-body enhancement of the electronic density of states at the Fermi energy which is described by a change of the itinerant-electron mass alone; the number of particles and the occupation of states in k space remain unchanged. We argue that CeB_6 represents a different limit of heavy-fermion behavior as compared to UPt_3.

6047 **Two-dimensional antiferromagnetic quantum spin-fluid state in La_2CuO_4.** Shirane, G.; Endoh, Y.; Birgeneau, R.J.; Kastner, M.A.; Hidaka, Y.; Oda, M.; Suzuki, M.; Murakami, T. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **59**: No. 14, 1613-1616(5 Oct 1987). Contract AC02-76CH00016.

Elastic, quasielastic, and inelastic neutron scattering measurements in La_2CuO_4 reveal novel two-dimensional antiferromagnetic behavior. At high temperatures the spins are ordered instantaneously over long distances two dimensionally but there is no measurable time-averaged staggered moment. The energy scale of the spin fluctuations is large, corresponding to an effective dispersion of approx. >0.4 eV A. The relevance to the high-temperature superconductivity in this class of materials is noted.

6048 **Comparison of the pressure dependencies of T/sub c/ in the 90-K superconductors RBa_2Cu_3O/sub x/ (R = Gd, Er, and Yb) and YBa_2Cu_3O/sub x/.** Borges, H.A.; Kwok, R.; Thompson, J.D.; Wells, G.L.; Smith, J.L.; Fisk, Z.; Peterson, A.D.E. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **36**: No. 4, 2404-2407(1 Aug 1987).

We have determined the effect of pressure P on the resistance and superconducting transition temperature T/sub c/ of RBa_2Cu_3O/sub x/ (R = Gd, Er, and Yb) and compare our results to those obtained on high quality YBa_2Cu_3O/sub x/. The transition temperature, which is 90 K or greater at ambient pressure for all four compounds, is enhanced by pressure in each at rates between 0.09 and 0.19 K/kbar. Interestingly, the presence of a localized moment in the rare-earth compounds appears to have no influence on the pressure response. From the positive dT/sub c//dP we infer a positive change in the thermal expansion upon entering the superconducting state.

6049 **(UCRL-Trans—12196) Combustion synthesis of transition metal nitrides under high nitrogen pressure.** Hirano, Kiyoshi; Miyamoto, Yoshinari; Koizumi, Mitsue. Translated from *Zairyo ;* **36**: No. 400, 12-16(Jan 1987). Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001640/JAW.

Studies were made on the synthesis of transition metal nitrides (TiN, ZrN, HfN, NbN and TaN) by the combustion reaction of metal powder compacts under 0.1 ~ 25 MPa nitrogen pressures. Under low nitrogen pressures (≃0.1 MPa), stoichiometric nitrides were not obtained in all cases due to incomplete supply of nitrogen gas into the powder compacts. Under high nitrogen pressures (≃10 MPa), it was found that the nitriding ratio of product depends on the adiabatic combustion temperature and melting point of nitrides. In the cases of Ti, Zr, Hf and Nb, which have quite high adiabatic temperatures compared with the melting points of the corresponding nitrides, the nitriding ratio was low (<80%) because of coalescing of metal particles by melting. In the cases of Ta and other metals with their nitride additions, which have the adiabatic temperatures close to the melting points of the corresponding nitrides, the stoichiometric nitrides were produced. 12 refs., 4 figs., 6 tabs.

6050 **Microstructure-mechanical property relationships in 94-percent alumina ceramics.** Hellmann, J.R.; Matsko, J.; Freiman, S.W.; Baker, T.L. pp 367-379 of Tailoring multiphase and composite ceramics; Proceedings of the Twenty-first University Conference on Ceramic Science, Pennsylvania State University, University Park, July 17-19, 1985. Tressler, R.E.; Messing, G.L.; Pantano, C.G.; Newham, R.E. New York, NY; Plenum Press (1986). (CONF-850705—).

From 21. University conference on ceramic science; University Park, PA, USA (17 Jul 1985).

The most common ceramic-to-metal seal processes involve a metallizing of the ceramic surface at elevated temperature with a paint composed of refractory metal particles, then brazing the metallized ceramic to the metal component at a lower temperature. The use of 94-percent aluminas in which the compositional balance is an MgO-CaO-Al_2O_3-SiO_2 glass phase allows the hermetic sealing of the components at a markedly lower temperature than would be possible if no glass phase were present. An evaluation is presently made of the effect of processing conditions on microstructural evolution in two aluminas of this type. In addition, the effect of microstructure on the strength, toughness, and fatigue resistance of the ceramics is quantified. 23 references.

3606 Other Materials

REFER ALSO TO CITATION(S) 5499, 5594, 5598, 5640, 5924, 6023, 6026, 6038, 6160, 6203, 6249, 6281, 6322, 6826, 6827, 6999, 7111

6051 **(AD-A—184268/1/XAB) Measurement of the electron density and the attachment-rate coefficient in silane/helium discharges. Technical report (Final), 12 July 1983-30 March 1986.** Fledderman, C.B.; Beberman, J.H.; Verdeyen, J.T.; Hebner, G.; Overzet, L.J. (Illinois Univ., Urbana (USA). Gaseous Electronics Lab.). Sep 1986. 84p. NTIS, PC A05/MF A01.

Discharge processing of semiconductor materials, either as an etch-process step in microelectronic fabrication, or as a deposition scheme for solar cell or copier applications, has become indispensable in modern technology. This report is focused on discharges used for such applications. The thesis by Fledderman was

a basic study of the attachment rate of electrons in discharges involving mixtures of silane and a rare gas as represented by helium. It was found that the primary attaching species was not the silane modecule but some daughter product created by the discharge. These results are indicative of the problems encountered in an attempt to model discharges in such gases: the rates for the radicals may be larger than that of the donor gases.

6052 **(BDX—613-3807) Primerless RTV silicones: Final report.** Tira, J.S. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Nov 1987. Contract AC04-76DP00613. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002662/JAW.

A survey and evaluation of 6 one- and two-part primerless RTV silicone adhesives, sealants, and encapsulation materials were conducted to gain working experience with these materials. A table of physical characteristics of each material was compiled; also, testing was performed and data reported for the following material properties: Shore A hardness, lap shear strength, dielectric strength, coefficient of thermal expansion, adhesion/180° peel with various plastic and metal materials, adhesion to silicone and rubber materials, and contact corrosion. 3 figs., 9 tabs.

6053 **(CERT—4193-VOL-1) Improving contamination plus irradiation tests. Complement to prestudy number 1. Volume 1: accelerated ultraviolet radiation. Volume 1: tests and conclusions. Final report.** Millan, P.; Paillous, A.; Sable, C.; Siffre, J. (Centre d'Etudes de Recherches, Toulouse (France)). Jan 1986. 47p. (In French). (ESA-CR(P)—2328-VOL-1; ETN—87-99877). NTIS, PC A03/MF A01.

Tests on spacecraft materials were carried out using ultraviolet irradiation either with 45 deg or normal incidence with Sun equivalent intensity or 4 times the equivalent with normal incidence. The duration of irradiation was up to 800 hr cumulative solar intensity. The comparison of results with those of previous tests shows that materials damage prediction in space can be deduced from data with a certainty of 0.025 for reflecting white paints and fabrics and up to 0.005 for metallized FE polymers. Results can show however large deviations which are difficult to explain. These abnormal results are discussed.

6054 **(CERT—4193-VOL-2) Improving contamination plus irradiation tests. Complement to prestudy number 1. effects of an increase in the intensity of ultraviolet radiation. Volume 2: detailed results. Final report.** Millan, P.; Paillous, A.; Sable, C.; Siffre, J. (Centre d'Etudes de Recherches, Toulouse (France)). Jan 1986. 99p. (In French). (ESA-CR(P)—2328-VOL-2; ETN—87-99878). NTIS, PC A05/MF A01.

Tests on spacecraft materials were carried out using ultraviolet irradiation either with 45 deg or normal incidence with Sun equivalent intensity of 4 times the equivalent with normal incidence. The duration of irradiation was up to 800 hr cumulative solar intensity. The comparison of results with those of previous tests shows that materials damage prediction in space can be deduced from data with a certainty of 0.025 for reflecting white paints and fabrics and up to 0.005 for metallized FE polymers. Results can show however large deviations which are difficult to explain. These abnormal results are discussed.

6055 **(CERT—4193-VOL-3) Improving contamination plus irradiation test. Prestudy number 3. Study of contaminant application procedures. Volume 1: tests and conclusions. Final report.** Millan, P.; Paillous, A.; Sable, C.; Siffre, J. (Centre d'Etudes de Recherches, Toulouse (France)). Jan 1986. 74p. (In French). (ESA-CR(P)—2328-VOL-3; ETN—87-99879). NTIS, PC A04/MF A01.

The contamination of three types of thermal protective coatings for space application was tested using the decomposition vapors of two types of adhesive. The deposits were controlled with quartz microscales before and after exposition to vacuum only, or vacuum combined with ultraviolet or proton radiation. The optical reflectance evolution was measured . It is concluded that both kinds of irradiation affect strongly the possibility of reflectance recovery after contamination. The results allow a better understanding of the degradation of the solar reflectance of satellite protective coatings.

6056 **(CERT—4193-VOL-4) Improving contamination plus irradiation tests. Prestudy number 3. Study of contamination application procedures. Volume 2: Detailed results. Final report.** Millan, P.; Paillous, A.; Sable, C.; Siffre, J. (Centre d'Etudes de Recherches, Toulouse (France)). Jan 1986. 207p. (In French). (ESA-CR(P)—2328-VOL-4; ETN—87-99880). NTIS, PC A10/MF A01.

The contamination of three types of thermal protective coatings for space application was tested using the decomposition vapors of two types of adhesive. The deposits were controlled with quartz microscales before and after exposition to vacuum only, or vacuum combined with ultraviolet or proton radiation. The optical reflectance evolution was measured. It is concluded that both kinds of irradiation affect strongly the possibility of reflectance recovery after contamination. The results allow a better understanding of the degradation of the solar reflectance of satellite protective coatings.

6057 **(CONF-871060—2-Draft) 400-nm photoluminescence of a color center in undoped YAG grown under reducing atmosphere.** Wu, G.; Williams, R.T.; Williams, G.P. Jr.; Chen, C.Y.; Chen, Y. (Wake Forest Univ., Winston-Salem, NC (USA); North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering; Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001760/JAW.

From Topical meeting on tunable solid state lasers; Williamsburg, VA, USA (26 Oct 1987).

We describe a color center in reduced YAG (yttrium aluminium garnet) which luminesces in a broad band centered around 400 nm with high quantum efficiency, 4 ns radiative lifetime, and comparatively small Stokes shift. 13 refs., 2 figs.

6058 **(DOE/ER/13203—T1) Determination of thermodynamic function of minerals at high temperatures: Final report, January 1, 1985 to April 15, 1986.** Anderson, O.L. (California Univ., Los Angeles (USA). Dept. of Earth and Space Sciences). 15 Jul 1987. Contract FG03-84ER13203. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001911/JAW.

We proposed to measure the elastic constants of NaCl, KCl, corundum (Al_2O_3) and almadine garnet. We also proposed to use these new data and the corresponding existing data already measured for MgO, Mg_2SiO_4 and Fe_2SiO_4 to calculate the thermodynamic functions of these minerals into the high temperature range. We finished the computations of the thermodynamic functions for MgO, and are partially through the computation of the thermodynamic functions for Mg_2SiO_4. We did not begin any work on Fe_2SiO_4: instead we targeted and worked out the phase diagram of iron between 100 to 300 GPa and 3000 to 6000 K. We finished measuring the elastic constants of NaCl and KCl at high temperatures, and the measurements of the room-temperature elastic constants of corundum. We finished the calculation of the thermodynamic functions for MgO and are partially finished with the calculations of the thermodynamic functions for Mg_2SiO_4. We have not yet begun the calculations of the thermodynamic functions on NaCl. We computed some thermodynamic properties for Fe and calculated the phase diagram of Fe up to earth core pressures. 23 refs., 17 figs., 2 tabs.

6059 **(DOE/ER/13482—2) Transport properties of disordered porous media from the microstructure: Progress report, March 1, 1987-February 29, 1988.** Torquato, S. (North Carolina State Univ., Raleigh (USA). Dept. of Mechanical and Aerospace Engineering). Oct 1987. Contract FG05-86ER13482. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002424/JAW.

Progress has been made in five general areas: (1) the development of new theoretical expressions for bulk properties of random media which depend upon the microstructure through various sets of statistical correlation functions, (2) the development of a systematic means to represent and calculate these correlation functions, for nontrivial models of porous media, using statistical-mechanical methods, (3) the calculation of property relations which depend upon this microstructural information, (4) the study of per-

colation in continuum models (e.g., suspensions of inclusions), and (5) the use of computer simulation techniques to "exactly" predict the effective properties of disordered media.

6060 **(DOE/ER/45156—T2) Ion mixing and surface modification in metal-semiconductor systems: Final technical report, August 1, 1984 to July 31, 1987.** Lau, S.S.; Mayer, J.W. (California Univ., San Diego, La Jolla (USA); Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). 1987. Contract FG03-84ER45156. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001702/JAW.

Objective was to understand the similarities and differences between thermal annealing (a steady-state process) behavior and ion-induced (a transient process) behavior in metal-semiconductor systems. There were three specific aspects of ion mixing in mind during the course of this investigation: Kirkendall marker motion in ion induced reactions; phase separation; and bilayered sample versus multi-layered sample. Each of the specific objectives was studied, the first issue was investigated with some details. The single most important finding in this investigation is the fact that the moving species during ion-induced reaction may be different from that during thermally induced reaction for a given system. This observation, together with the knowledge of how to change the moving species during ion mixing, enable us to design materials of desired composition and phases not achievable with conventional means. While we have established some of the phenomenological correlations between ion induced and thermal reactions, the basic mechanisms for the change of moving species during ion-mixing requires further study. 13 refs., 13 figs., 1 tab.

6061 **(EUR—10582) High reducibility of sinter with low degradability: Final report.** Pignatelli, C. (Nuova Italsider S.p.A., Genoa (Italy)). 1986. 81p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900128/JAW.

Aims of the research were: to improve the quality of the sinter, in particular its reducibility and degradability; or, alternatively, to maintain the same standard of sinter quality while improving plant performance. The study related to the influences on the sintering process and sinter quality resulting from variations in: the degree of oxidation of the sinter; the permeability of the mixtures, by modifying the quantities of aerated quicklime or "concentrated" ores in the mixture, or by acting on the combustion conditions; and the type and grain-size distribution of the magnesia additions. Results: Lower FeO concentration of the sinter made it possible to increase the reducibility of the sinter by two or three percentage points without detracting from its degradation index. The use of fine-grained olivine produced a sinter with lower degradability as a result of the greater reactivity of the SiO_2 contained therein. Research confirmed the favorable influence, on plant productivity and the specific heat consumption of the process of the aerated quicklime added to the sintering mixtures. There are, however, limits to the use of quicklime because of its cost. Variations in the combustion conditions had varying influences on the process parameters and product quality. "Concentrated" ores exerted an adverse effect on the permeability of the mixtures, but the silica present in the very fine fractions of these ores made it possible to improve certain aspects of sinter quality. 3 refs., 13 figs., 20 tabs.

6062 **(EUR—10937) Historical examination of concrete.** Mallinson, L.G.; Li Davies, I. (Commission of the European Communities, Luxembourg). 1987. 315p. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88750627/JAW.

The requirement that concrete in radioactive waste repositories be stable physically and chemically for very long times has initiated studies of ancient and old concretes. This report is a contribution to this effort. After a description of the history of cement and concrete, the published literature relating to the analysis of old and ancient concrete is reviewed. A series of samples spanning the history of concrete has been obtained; a variety of physical and chemical techniques have been employed to characterize these samples. Reasons for survival of ancient concretes, and for durability of early, reinforced concretes are identified. Recommendations for further studies are given. 132 refs.

6063 **(Juel-Spez—401) Comparison of high purity fine grain graphites from different suppliers with regard to physical, mechanical and thermal properties. Final report.** Delle, W.; Linke, J.; Nickel, H.; Wallura, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). May 1987. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750541/JAW.

By order of the Jet Joint Undertaking, European Atomic Energy Community, eight high purity fine grain graphites and one carbon fibre composite were investigated with regard to a number of properties as far as to their thermal shock behaviour. The following properties were determined: Apparent density, total and open porosity, electrical resistivity between room temperature and 1000degC, thermal conductivity between 100degC and 1000degC, linear thermal expansion between room temperature and 1000degC, dynamic Young's modulus, bending strength and fracture deflexion. A number of impurities - including sulfur - were determined. Multielement analytical methods, such as spark source mass spectrometry and optical atom emission spectrometry with excitation in an inductively coupled plasma, were used rendering the simultanious detection of about 45 elements. Sulfur was detected by the classical method of burning to SO/sub 2/ and application of infrared. Four series of thermal shock and erosion experiments were carried out on all graphites and the carbon fibre composite. For this purpose, graphite samples were exposed to a defocussed electron beam of different power densities and pulse durations. The erosion behaviour of the particular materials differred significantly.

6064 **(LA-UR—87-3117) New theories for smectic and nematic liquid-crystal polymers: Backbone LCPs [liquid crystalline polymers] and their mixtures and side-chain LCPs.** Dowell, F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 26p. (CONF-8708171—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88000536/JAW.

From 6. international symposium on liquid crystals and ordered fluids; New Orleans, LA, USA (30 Aug 1987).

A summary of predictions and explanations from statistical-physics theories for both backbone and side-chain liquid crystalline polymers (LCPs) and for mixtures with backbone LCPs are presented. Trends in the thermodynamic and molecular ordering properties have been calculated as a function of pressure, density, temperature, and molecule chemical structures (including degree of polymerization and the following properties of the chemical structures of the repeat units: lengths and shapes, intra-chain rotation energies, dipole moments, site-site polarizabilities and Lennard-Jones potentials, etc.) in nematic and multiple smectic-A LC phases and in the isotropic liquid phase. The theoretical results are found to be in good agreement with existing experimental data. These theories can also be applied to combined LCPs. Since these theories have no ad hoc or arbitrarily adjustable parameters, these theories can be used to design new LCPs and new solvents as well as to predict and explain properties. 27 refs., 4 tabs.

6065 **(LBL—23800) Sintering and densification of particulate composites: Inclusion size and clustering.** Weiser, M.W. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002230/JAW.

Previously, attempts have been made to explain the lower densification rates observed in ceramic bodies containing inclusions in terms of hydrostatic back stresses that arise out of the matrix shrinking around the inclusion. These models can account for the observed dependence of the densification on the volume fraction of inclusions. However, they fail to account for the observed large differences in densification for inclusions of different sizes. It is proposed that the lower densification for smaller inclusions is a consequence of both a thin matrix layer at the inclusion's surface that densifies less readily than the bulk and the clustering that can occur more readily among smaller inclusions. The observed lower densification rates are a function of the volume fraction, size, degree of inclusion clustering, and the processing during powder mixing. These lower densification rates can be treated as the effective volume fraction of the second phase being greater than the volume

fraction that is actually present. An experimental investigation was conducted on ZnO/SiC composite, with a computer simulation of clustering. 61 refs., 147 figs., 1 tab.

6066 **(N—87-26976) Effects of high energy radiation on the mechanical properties of epoxy/graphite fiber reinforced composites. Interim report, 1 January-31 October 1986.** Fornes, R.E.; Gilbert, R.D.; Memory, J.D. (North Carolina State Univ., Raleigh (USA)). Oct 1986. 167p. (NASA-CR—180310; NAS—1.26:180310). NTIS, PC A08/MF A01.

The epoxy resin system formed by tetraglycidyl 4,4'-diamino diphenyl methane (TGDDM) and 4,4'-diamino diphenyl sulfone (DDS) was characterized by dynamic mechanical analysis and differential scanning calorimetry. Dynamic mechanical properties of graphite fiber epoxy composite specimens formulated with two different adhesive systems (NARMCO 5208, NARMCO 5209) were determined. The specimens were exposed to varying dose levels of ionizing radiation (0.5 MeV electrons) with a maximum absorbed dose of 10,000 Mrads. Following irradiation, property measurements were made to assess the influence of radiation on the epoxy and composite specimens. The results established that ionizing radiation has a limited effect on the properties of epoxy and composite specimens.

6067 **(N—87-26980) Effects of high energy radiation on the mechanical properties of epoxy/graphite fiber reinforced composites. Final technical report.** Fornes, R.E.; Gilbert, R.D.; Memory, J.D. (North Carolina State Univ., Raleigh (USA)). Jul 1987. 65p. (NASA-CR—181110; NAS—1.26:181110). NTIS, PC A04/MF A01.

Publications and theses generated on composite research are listed. Surface energy changes of an epoxy based on tetraglycidyl diaminodiphenyl methane (TGDDM)/diaminodiphenyl sulfone (DDS), T-300 graphite fiber and T-300/5208 (graphite fiber/epoxy) composites were investigated after irradiation with 0.5 MeV electrons. Electron spin resonance (ESR) investigations of line shapes and the radical decay behavior were made of an epoxy based on tetraglycidyl diaminodiphenyl methane (TGDDM)/diaminodiphenyl sulfone (DDS), T-300 graphite fiber, and T-300/5208 (graphite fiber/epoxy) composites after irradiation with Co(60) gamma radiation or 0.5 MeV electrons. The results of the experiments are discussed.

6068 **(N—87-27034) Space environmental effects on polymeric materials. Semiannual status report, 1 March 1986-1 January 1987.** Kiefer, R.L.; Orwoll, R.A. (College of William and Mary, Williamsburg, VA (USA)). Feb 1987. 15p. (NASA-CR—180336; NAS—1.26:180336). NTIS, PC A02/MF A01.

A study is presented of the effect of radiation on polymers. It helps to estimate the impact of the space environment on composite structures. Two commercially available polymer films were used; a polyetherimide, and a polysulfone. Both films were irradiated in vacuum with 85 KeV electron. Properties of the films before and after irradiation were monitored by tensile elongation measurements, ultraviolet/visible spectroscopy, glass transition temperature measurements, gel permeation chromatography, and infrared spectroscopy. The results of these characterizations are presented and briefly discussed.

6069 **(N—87-27523) Material growth and characterization for solid state devices. Report, 1 June 1985-31 December 1986.** Collis, W.J.; Abul-Fadl, A.; Iyer, S. (North Carolina Agricultural and Technical State Univ., Greensboro (USA)). Mar 1987. 35p. (NASA-CR—180688; NAS—1.26:180688). NTIS, PC A03/MF A01.

During this period InGaAs and InGaAsP were grown on (100)InP by liquid phase electroepitaxy (LPEE). Results of the epitaxial growth of InGaAs on sputtered quartz masked substrates are presented. The resulting surface morphology can be related to the current density distribution near the edges of a masked pattern. The quaternary InGaAs was grown with compositions corresponding to 1.3 micron and 1.5 micron emission wavelengths. Growth rates were found to be linearly dependent upon current density, and a strong dependence upon composition was noted. These compositions lie in the miscibility gap region of the alloy phase diagram at the 645 C growth temperature. Growths were performed at 685 C to avoid the miscibility gap. Epilayers were characterized by photoluminescence, x-ray diffraction, secondary ion mass spectrometry, and Hall effect measurements. Aluminum oxide was deposited on silicon and InGaAs substrates for the characterization of this material as an insulator in a field effect transistor structure. It was determined that the results did not warrant further work with the deposition from an aluminum isopropoxide source. A metallographic vapor phase epitaxy system installation is nearing completion for use in hybrid III-V semiconductor epilayer growths.

6070 (N—87-28430, pp 13) **Hall Effect.** Dec 1985. NTIS, PC A04/MF A01. (NASA-CR—181255; NAS—1.26:181255).

In Activities of the Solid State Physics Research Institute. Annual report, 1 January-31 December 1985.

The experimental procedure consists of the measurement of the Hall coefficient, resistivity, and Hall mobility as a function of temperature of a sample of gallium arsenides before and after irradiation with low and high energy protons. Work has begun on the development of the theory and subsequently experiments will be designed and performed.

6071 **(RISO-M—2643) Yield in adhesive joints and design of zones with constant elastic shear stresses.** Waagepetersen, G. (Risoe National Lab., Roskilde (Denmark)). May 1987. 39p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750393/JAW.

A method is given which based on a simple elastic-plastic model shows the distribution of shear stresses in the adhesive and gives a total picture of the development of the length of the yield zones and their strain as a function of load. Methods are given for the design of adhesive joints with constant elastic shear stresses in the ends of the adhesive or throughout the whole length of the adhesive, obtained by varying the thickness of the adherends or of the adhesive or a combination of both. The characteristic yield properties of such designs are being determined. Internal stresses after yield and unloading are determined, and modified stress-distribution for new load is found. The constant elastic shear stress zones can be designed taking all relevant factors into consideration including various temperature stresses, bending moments in the adherends etc. Thereby zones with constant stresses will be general usable also for single lap joints.

6072 **(RISO-M—2659) Beam theory stresses in an adhesive lapjoint.** Krenk, S. (Risoe National Lab., Roskilde (Denmark)). Sep 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750385/JAW.

The problem of adhesive stresses in a single lapjoint is formulated as an elasticity problem for shear flexible beams. The loads include normal force, shear force, moment, and thermal expansion corresponding to a linear temperature variation over the thickness of each laminate. The theory is implemented in an interactive Pascal program to be run on an IBM-compatible personal computer.

6073 **(SAND—87-0127C) The effective elastic properties of low-density foams.** Warren, W.E.; Kraynik, A.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 45p. (CONF-871228—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014629/JAW.

From Symposium on constitutive modeling for nontraditional materials; Boston, MA, USA (12 Dec 1987).

Theoretical micromechanical models for the elastic response of solid foams are developed. Idealized two-dimensional closed-cell foams are considered to be spatially periodic with either hexagonal or square network structure; while three-dimensional open-cell foams are assumed to be composed of randomly oriented tetrahedral or cubic elements. The thickness of films in two-dimensional foams and struts in three-dimensional foams is permitted to vary with distance from their mutual joints. The effective elastic constants are explicitly related to the compliances for bending and stretching of the individual films and struts. For small strains, bending is the primary distortional mechanism for low-density foams

whose structure is consistent with minimal surface area - hexagonal and tetrahedral structure. Two-dimensional foams with hexagonal structure and with linear elastic films exhibit nonlinear elastic response for large deformations; this stems from the increasing role of film stretching due to geometrical effects associated with large cell distortion. 38 refs., 10 figs., 1 tab.

6074 **(SAND—87-0375) A rapid polishing method for KBr and NaCl infrared windows.** Oborny, M.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002480/JAW.

A method is described for polishing KBr and NaCl infrared windows which provides a considerable time savings compared to conventional polishing techniques using abrasive compounds. Windows polished by this method have been found to be suitable for most applications in infrared spectroscopy. 2 refs., 1 fig.

6075 **(SAND—87-0541C) Reactions and bonding between glasses and titanium.** Brow, R.K.; Watkins, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 22p. (CONF-871207—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000603/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Hermetic seals between titanium and both silicate and alkaline earth boroaluminate glasses have been made. Mechanical testing of pin-seal configurations indicate that the boroaluminate glass seals are at least 50% stronger than the silicate glass seals. To explain these differences, the interfacial chemistries of the two systems were characterized by a number of techniques, including x-ray photoelectron spectroscoy (XPS). Titanium-silicide and titanium-boride phases were found, respectively, at the silicate- and boroaluminate-titanium interfaces. Thermochemical calculations were done to describe the redox conditions necessary to produce the interfacial reaction products. We find that the rapid development of a relatively thick silicide interfacial phase adversely affects the strength of a silicate glass-titanium seal, while the formation of a thinner boride phase does not affect the properties of the boroaluminate glass seals. 11 refs., 6 figs., 2 tabs.

6076 **(SAND—87-1144C) Effect of the band-gap characteristics on laser-induced dry etching of semiconductors.** Ashby, C.I.H.; Biefeld, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-871027—38). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001853/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The carrier-driven photochemical dry etching of both direct- and indirect-gap semiconductors depends strongly on the depth of generation of free carriers and the recombination behavior of those carriers. While excitation across the lowest energy gap, E_0, of a direct semiconductor produces many near-surface carriers to drive etching, too few carriers may be generated near the surface by excitation across E_0 of an indirect semiconductor for etching to occur. However, excitation across the direct E_1 gap of an indirect semiconductor produces sufficient near-surface carriers for rapid etching. Enhanced bulk carrier recombination in very heavily doped materials can suppress etching in both direct and indirect semiconductors. This paper studied GaAs/sub 1-x/P. 7 refs., 2 figs.

6077 **(SAND—87-1752C) Structure of layered crystals studied by high energy ion beams.** Picraux, S.T.; Dawson, L.R.; Tsao, J.Y.; Doyle, B.L.; Lee, S.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 23p. (CONF-8710159—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001675/JAW.

From 12. international conference on atomic collisions in solids; Okayama, Japan (12 Oct 1987).

This paper reviews the use of MeV ion channeling techniques for the characterization of strained-layered structures. We present new results for the analysis of semiconductor heteroepitaxial surface layers and buried layers, and review previous results for strained-layer superlattices. Three inclined-direction channeling approaches are discussed: angular scans to measure the strain in the upper layers, dechanneling as a function of depth to provide a depth-resolved monitor of the strain, and catastrophic dechanneling in planes to measure small strains in superlattices. Along the growth direction we discuss the use of dechanneling by misfit dislocations to measure strain relief. 14 refs., 8 figs.

6078 **(SAND—87-2328C) Structural relaxation in strained-layer heterostructures.** Dodson, B.W.; Tsao, J.Y. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-871027—39). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002326/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The relaxation of misfit strain in metastable structures by plastic flow is described using a continuum model based on Haasen's picture of plastic flow in bulk diamond-phase semiconductors. This model provides an explanation of the relaxation behavior of metastable strained-layer structures, as well as the "metastable" critical thicknesses reported in many semiconductor strained-layer experiments. We also introduce a compact means of summarizing the stability behavior of such structures by introducing an analog to the deformation-mechanism maps of Ashby and Frost, which have provided an elegant means of describing plastic deformation in bulk materials. 16 refs., 4 figs.

6079 (SERI/CP—233-2959, pp 198) **Poly-[tris-5,5'dicarbo(3-acrylato-l-propoxy)bipyridine ruthenium] modified electrodes.** Elliott, C.M.; Redepenning, J.G.; Schmittle, S.J.; Balk, E. (Colorado State Univ., Fort Collins). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Polymer films prepared from the monomeric complex RuL_6^{+2} where L = 5,5'-dicarbo(3-acrylato-1-propoxy)-2,2'bipyridine have been investigated. Electronic conductivity has been observed in all the cases studied. The polymer film also exhibits a fast response for thick films and excellent cycle stability. The negative reduction potential of these films make them very sensitive to O_2 and moisture.

6080 **(UCID—21194) Viscoelastic properties of EA951 adhesive: A source of creep deformations of a strongback.** Feng, W.W. (Lawrence Livermore National Lab., CA (USA)). 28 Sep 1987. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001581/JAW.

Both creep and relaxation functions for EA951 adhesive are presented. During this study, we have found that the adhesive used in the bonding of the facing sheet and the NOMAX of a strongback crept from 0.6% of strain to 2% in about 10 days at room temperature. Other materials, such as F263 epoxy used in the strongbacks, did not creep at room temperature. Therefore, we concluded that the creep in strongbacks observed by Schauer was due to the adhesive. We then recommended that the EA951 adhesive be replaced with FM355 adhesive. The creep phenomenon for the new strongback, constructed with the new adhesive, was eliminated. 2 refs., 8 figs.

6081 **(UCID—21250) Thermal stress analysis of a cooled monochromator crystal.** Johnson, G.L.; Holdener, F.R.; Tirsell, K.G. (Lawrence Livermore National Lab., CA (USA)). 24 Nov 1987. Contract W-7405-ENG-48. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002116/JAW.

Wiggler x-ray monochromator designs must take full advantage of crystal geometric design, cooling method, and material properties to obtain peak performance. Objectives were (1) to better understand the effect of beam power profile, crystal thickness, and crystal cooling scheme on crystal performance and (2) to recommend an improved crystal cooling design. Five parameters were investigated (1) cooling scheme: bottom-cooled vs side-cooled, (2) full surface cooling vs localized cooling, (3) crystal

thickness: 2 mm to 32 mm, (4) heat exchanger conductive interface material: silicone grease vs low-melting temperature metal, and (5) material property definition: constant vs temperature-dependent. Side cooling of thick crystals provided no major improvement in performance over bottom cooling. Crystal performance did not change radically for thicknesses above 12 mm. The performance of thin (<8 mm), bottom-cooled crystals was considerably dependent on the convective boundary conditions at the cooled surface. Also, a cooling design with a high conductivity metal as an interface with the crystal improved performance for all thicknesses. 9 refs., 45 figs., 6 tabs.

6082 **(UCRL—95281) Influence of post-deposition treatment by UV light and oxygen (ozone) on 350 nm damage thresholds of SiO_2 films deposited from sols.** Thomas, I.; Wilder, J.; Lee, A.; George, D. (Lawrence Livermore National Lab., CA (USA)). 30 Jun 1987. Contract W-7405-ENG-48. 8p. (CONF-8710165—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000975/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

Certain multilayer porous silica AR (antireflection) coatings on fused silica substrates prepared by the sol-gel process have been found to have a much lower laser damage threshold than single layer coatings prepared by the same method. Treatment with uv light in the presence of oxygen (which gives ozone) at low temperatures was found to restore damage thresholds to the levels found in single layers. Damage thresholds were measured at 350 nm with a 25 ns pulse for 1000 shots at 25 Hz. The effect of exposure time and other factors such as replacement of oxygen with nitrogen and vacuum are described. 1 ref., 2 figs., 1 tab.

6083 **Wavelength- and thickness-independent optical coatings for integrated circuit metallization layers.** Draper, B.L.; Mahoney, A.R.; Bailey, G.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 11, 4450-4452(1 Dec 1987). Contract AC04-76DP00789.

Detailed measurements have been made of the optical properties of sputtered tantalum silicide films on aluminum layers used in integrated circuit fabrication. This new multicomponent conductor (TaSi/sub x/ on aluminum), which is currently in use because of its exceptional electrical, physical, and chemical properties, was also found to have superior optical properties compared to aluminum alone. The addition of the thin silicide layers reduces both the total hemispherical and diffuse reflectance properties by up to 45% over the 265—800-nm wavelength range with almost no dependence on film thickness. Unlike other optical coatings used on metal layers in integrated circuit manufacturing, the silicide films do not need to be removed after photolithography and pattern transfer processes are completed: aluminum wire bonding from the completed circuit (with silicide coating) to the package is highly reliable and reproducible.

6084 **Effectiveness of strained-layer superlattices in reducing defects in GaAs epilayers grown on silicon substrates.** El-Masry, N.; Tarn, J.C.L.; Humphreys, T.P.; Hamaguchi, N.; Karam, N.H.; Bedair, S.M. (Material Science and Engineering Department, North Carolina State University, Raleigh, North Carolina 27695). *Applied Physics Letters;* **51**: No. 20, 1608-1610(16 Nov 1987).

In GaAs-GaAsP strained-layer superlattices grown lattice matched to GaAs are effective buffer layers in reducing dislocations in epitaxial GaAs films grown on Si substrates. The strained-layer superlattice structure permits high values of strain to be employed without the strained-layer superlattice generating dislocations of its own. We find that the strained-layer superlattice buffer is extremely effective in blocking threading dislocations of low density and is less effective when the dislocation is high. It appears that for a given strained-layer superlattice there is a finite capacity for blocking dislocations. Transmission electron microscopy has been used to investigate the role of the superlattice buffer layer.

6085 **Concentration dependence of the octahedral Ti/sup 4+/ center in $LiNbO_3$: Its effect on refractive indices.** Skeath, P.; Elam, W.T.; Burns, W.K.; Stevie, F.A.; Briggs, T.H. (Naval Research Laboratory, Washington, DC 20375-5000). *Physical Review Letters;* **59**: No. 17, 1950-1953(26 Oct 1987).

X-ray absorption spectra of titanium-diffused $LiNbO_3$ indicate that a strong change in the Ti center appears as the concentration is increased above 5 x 10/sup 20/ cm/sup -3/, involving a tendency toward displacement in the x-y plane and disorder. This change in the Ti center occurs within the concentration range used for integrated-optical-device fabrication, and may account for the abrupt decrease in rate of change of the ordinary optical index (n_o) with increasing Ti concentration reported in the literature.

6086 **Low-temperature heat-capacity study of superconducting ternary silicides and germanides with the Sc_5Co_4Si/sub 10/-type structure.** Hausermann-Berg, L.S.; Shelton, R.N. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **35**: No. 13, 6659-6664(1 May 1987).

The results of low-temperature specific-heat experiments on eleven superconducting compounds belonging to the ternary system R_5T_4X/sub 10/ (R = Sc, Y, and Lu; T = Co, Rh, Ir, and Os; X = Si and Ge) are presented. Analysis of the data yields relatively high Debye temperatures for the silicides (300—600 K), as well as large values for $\Delta C/\gamma T$/sub c/ (2.8—4.9) and the electron-phonon interaction λ (0.60—0.75) for the high-T/sub c/ compounds Sc_5Rh_4Si/sub 10/, Sc_5Ir_4Si/sub 10/, and Y_5Os_4Ge/sub 10/, indicating that these are strong-coupled superconductors. The analysis also indicates that a large contribution of the anharmonic term to the total specific heat in the normal state is present in the low-T/sub c/ compounds. It is apparent that the phonon spectra of these Sc_5Co_4Si/sub 10/-type materials are quite complex.

6087 **Small angle x-ray scattering with the metallic glass Fe/sub 80/B/sub 16/Si/sub 2/C/sub 2/.** Lamparter, P.; Kroeger, D.M.; Spooner, S. (Max-Planck-Institut fur Metallforschung, Institut fur Werkstoffwissenschaften, D-7000 Stuttgart). *Scripta Metallurgica;* **21**: No. 5, 715-720(May 1987).

Small angle X-ray scattering (SAXS) experiments have been performed with the metallic glass Fe/sub 80/B/sub 16/Si/sub 2/C/sub 2/ prepared by melt spinning. Embrittling but non-crystallizing anneals were found to increase the small angle scattering effect. Microadditions of cerium, which retard annealing embrittlement, also retard the increase of the SAXS. During the present work we took note of a recent study where the annealing embrittlement of a glass quite close in composition to the present one was investigated by SAXS.

6088 **On the volume fraction dependence of particle limited grain growth.** Doherty, R.D.; Srolovitz, D.J.; Rollett, A.D.; Anderson, M.P. (Dept. of Materials Engineering, Drexel Univ., Philadelphia, PA 19104). *Scripta Metallurgica;* **21**: No. 5, 675-680(May 1987).

The purpose of this paper is to offer an analytical model that accounts for the different variation of the limiting grain radius with volume fraction of particles found in previous computer simulations as compared to the classic Zener predictions. The effect of particles, seen both in the simulations and in the predictions, is to cause grain growth to cease at some limiting grain size. The source of the discrepancy arises from Zener's assumption of random particle/grain boundary intersections. The computer simulation, on the other hand, shows a high correlation between boundaries and particles.

6089 **Photovoltaic properties of amorphous silicon produced by reactive sputtering.** Moustakes, T.D. (Corporate Research Lab., Exxon Research and Engineering Co., Annandale, NJ 08801). pp 9-29 of Materials and new processing technologies for photovoltaics. Kapur, V.K.; Dismukes, J.P.; Pizzini, S. Pennington, NJ; The Electrochemical Society (1985). (CONF-841058—).

From Fall meeting of the Electrochemical Society; New Orleans, LA, USA (7 Oct 1984).

This paper reviews the photovoltaic properties of amorphous silicon produced by RF diode reactive sputtering. It is divided into three sections. The first part deals with the properties of the intrinsic films. The importance of structural and compositional inhomogeneities, and the role of hydrogen and trace impurities in defining the optoelectronic properties of the material are discussed. The second part deals with the properties of the doped films produced either by gas phase doping or by sputtering from doped targets. Comparison is drawn between totally amorphous and partially crystallized doped films and the superiority of the latter for photovoltaic applications is stressed. Finally, the third section deals with device studies. Solar cells, having the configuration substrate/NIP/ITO, generate external currents of 13 MA/cm/sup 2/ and open circuit voltages of between 0.85 to 0.95 volts. The author suggested ways to improve the Voc, Jsc and FF. Finally, unoptimized tandem solar cell structures and PIN solar cells with the doped layers deposited from doped targets have been presented. The results presented in this paper suggest that the photovoltaic properties of the sputtered material are equivalent to those of material produced by the method of glow discharge decomposition of silane.

6090 **Li and H concentration profiles in LiNbO/sub 3/ waveguides measured by nuclear techniques.** Canali, C.; Carnera, A.; Mazzi, G.; Mazzoldi, P.; Arnold, G. (Istituto di Elettrotecnica e di Elettronica - Via Gradenigo 6A, 35131 Padova). pp 43-46 of IOOC-ECOC '85 (Technical Digest). Rome Italy; Instituto Internazionale Delle (1985). (CONF-8510144—).

From 5. international conference on integrated optics and optical fibre communication and 11. European conference on optical communications; Venice, Italy (1 Oct 1985).

Lithium and hydrogen in-depth distribution profiles have been measured on LiNbO/sub 3/ single crystals by means of the Elastic Recoils Detection Analysis (ERDA) technique to characterize the composition of the surface waveguiding layers.

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REFER ALSO TO CITATION(S) 5984

6091 **(CONF-8710136—Summs.) 6th DOE catalysis and surface chemistry research conference: Summary of DOE-BES research projects.** (USDOE Office of Energy Research, Washington, DC. Office of Basic Energy Sciences). Oct 1987. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88000652/JAW.

From 6. DOE catalysis and surface chemistry research conference; Gaithersburg, MD, USA (14 Oct 1987).

Descriptions are given of 70 research projects. (DLC)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 5384, 5388, 5432, 5501, 5557, 5645, 6018, 6170, 6171, 6173, 6174, 6175, 6176, 6177, 6178, 6181, 6192, 6208, 6389, 6454, 6826

6092 **(CNIC—00021) Neutron activation analysis of ultrabasis rock by Ge(Li) γ-ray spectrometry and group separation.** Chen Baoguan; Yuan Ling; Fang Chanmeng. (Academia Sinica, Beijing, China. Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). 1986. 9p. (In Chinese). (IAE—0015). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700754/JAW.

The analytical procedure for determination of 21 elements in two ultrabasis rock samples with Ge(Li) gamma-ray spectrometry and group separation was described. 8 elements including Cr, Fe, Co, Sc, Mn, Na, Cl and Br have been directly determined by INAA. 13 elements including La, Ce, Nd, Sm, Gd, Eu, Tb, Ho, Tm, Yb, Lu, Zn and Cs have been determined by radiochemical separation. The samples of international standard AGV-1 (Andesite) have also been analyzed. The agreement of the results with the values proposed by F.J.Flanagan is satisfactory.

6093 **(CONF-871038—4) Crown ethers as solvent extraction reagents: Where do we stand?.** McDowell, W.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002313/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

Among the first applications of crown ethers was their use as solvent extraction reagents. In 1962 the compound 2, 3, 11, 12-dibenzo-1, 4, 7, 10, 13, 16-hexaoxacycloocta-2, 11-diene, now called dibenzo-18-crown-6, was identified and found to form alkali-metal-salt adducts soluble in organic solvents. These extraction properties of crown ethers were later used to compare the complex-formation properties of metal ions with crown ethers, and it was observed that salts of organophilic anions were more readily transferred to aprotic solvents. Picrate salts were extensively used in this role. However, analytical or process applications of the complexing abilities of macrocycles needed the aqueous anion to be one of the more common mineral acid anions. In the late 1970's, it was discovered that crown ethers mixed with an organophilic cation exchanger such as alkyl phosphoric, alkyl-aryl sulfonic, or carboxylic acid would produce synergistic extraction systems having excellent and selective affinities for a large number of metal ions. In 1981, macrocyclic compounds with attached carboxylic acid groups were synthesized and found to be excellent extractants. In addition to liquid-liquid extraction, much work has been done using macrocycles as separation agents in membranes and resin beads. Fundamental research, not covered in this paper, is now beginning to provide the stoichiometries and structures of some of the organic-phase complexes produced. Further, some potential uses of these systems are beginning to be identified and applied. 115 refs., 2 figs.

6094 **(CONF-871038—6) The synergistic solvent extraction of manganese by macrocyclic crown ethers in combination with didodecylnaphthalene sulfonic acid: Effect of macrocycle substituents.** Chadwick, R.B.; McDowell, W.J.; Baes, C.F. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002299/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

Crown ethers in combination with organophilic cation exchangers synergize the extraction of certain metal ions from aqueous solutions, and their selectivity has been thought largely dependent on the correspondence between the crown other's cavity diameter and the metal ion diameter. This work focuses on two crown others, tert. -butylbenzo-15-crown-5 (LBB15C5) and tert.-butylcyclohexano-15 -crown-5 (LBC15C5), each of which has a cavity diameter of 1.7 to 2.2 x 10^{-10} m and their extraction of Mn^{2+} (ionic diameter 1.4 to 2.2 x 10^{-10} m) from aqueous nitrate solutions. The organophilic cation exchanger used was didodecylnaphthalene sulfonic acid (HDDNS). The data show no observable complexes of the manganese salt of HDDNS with the benzo-substituted crown, tBB15C5, but the cyclohexano-substituted crown, LBC15C5, forms a strong complex with $Mn(DDNS)_2$. The system LBC15C5/HDDNS is an effective phase-transfer agent for manganese. Since the cavities in the two crown others are the same size, it appears that the difference observed between the benzo- and cyclohexano-subsitituted crowns are due to their different substituents. 23 refs., 6 figs.

6095 **(CONF-8710194—1) Fiber optics refractometer for absorption machines.** Bostick, D.A.; Klatt, L.N.; Perez-Blanco, H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002296/JAW.

From Heat transfer symposium; Urbana, IL, USA (1 Oct 1987).

Monitoring solution concentration in lithium bromide absorption units is of great importance to improve the thermal efficiency and the controllability of the units. The conventional way to measure concentration in lithium bromide water absorption machines is by means of refractometers. This technique requires the extraction of a sample from the machine. In situ, real time measurements are then difficult, and implementing control strategies is impossible. The fiber optic refractometer described in this work is ca-

pable of monitoring concentration in situ, giving instantaneous readings. The device consists of light sources, light detectors, and fiber optics with a surface treatment that enables them to measure the index of refraction of the solution. The instrument is described and results showing its usefulness presented. 3 refs., 8 figs., 2 tabs.

6096 **(DOE/ER/60431—2) Field-flow fractionation in the analysis of energy-related materials: Progress report for period April 1, 1987-March 31, 1988.** Giddings, J.C. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). Oct 1987. Contract FG02-86ER60431. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002105/JAW.

During the past year advances have been made in the areas of basic particle characterization, steric FFF, cyclical-field FFF, and energy-related applications. This report contains a brief description of four manuscripts which have been prepared for publication: Experimental Observation of Steric Transition Phenomena in Sedimentation Field-Flow Fractionation, Particle Separation and Characterization by Sedimentation/Cyclical-Field Field-Flow Fractionation, Analysis of Humic Substances Using Flow Field-Flow Fractionation, Separation and Characterization of Colloidal Materials of Variable Particle Size and Composition by Coupled Column Sedimentation Field-Flow Fractionation.

6097 **(ENEA-RT-TIB—85-1) Evaluation of analytical techniques to determine matals in Sodium. I-Flame atomic absorption spectroscopy.** Biancificri, M.A.; Zappa, G.; Amico, A. (ENEA, Casaccia, Italy. Dipt. Tecnologie Intersettoriali di Base). (ENEA, Rome (Italy)). 1985. 127p. (In Italian). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700763/JAW.

The influence of some instrumental parameters on the analysis of CA, Co, Cr, Cu, Fe, K, Mg, Mn, and Ni in Sodium solutions, by means of Flame Atomic Absorption Spectroscopy (FAAS), is evaluated. The best operating parameters are established and the possibility of application of this analytical technique to the detection of the metallic impurities in Sodium is evaluated, considering the concentration values of nuclear interest.

6098 **(IAEA-R—3660-F) Deuterium isotope composition of palaeoinfiltration water trapped in speleothems. Final report for the period 1 December 1984 - 30 November 1986.** Rozanski, K. (Institute of Physics and Nuclear Techniques, Krakow, Poland). (International Atomic Energy Agency, Vienna (Austria)). May 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700609/JAW.

Analytical and methodological aspects of combined isotope investigations of carbonate cave deposits are thoroughly discussed in the report. Weight is put on isotope analyses of fluid inclusions (D and /sup 18/O content) extracted from speleothems of known age. Dating was done by the /sup 230/Th//sup 234/U ratio method. Isotopic analyses of speleothems originating from European caves allowed some important conclusions to be formulated regarding past climatic and environmental conditions prevailing over the European continent during the last 300,000 yrs: a) δD values of fluid inclusions suggest a remarkable constancy of the heavy-isotope content of European palaeoinfiltration waters recharged during interglacial periods, b) a climate-induced, long-term changes in isotopic composition of precipitation and surface air temperature over Europe can be characterized by the deuterium gradient of ca.1 4 deg./oo/deg. C, c) an apparent constancy of the continental gradient in deuterium content of European palaeoinfiltration waters as judged from the fluid inclusion data suggests that atmospheric circulation over Europe did not undergo substantial changes for at least 300,000 years. 5 refs.

6099 **(INIS-BR—898) Isotopic determinations of carbon and oxygen in the metasedimentary rocks of the Rio Pardo group-Bahia State, Brazil.** Costa Pinto, N.M.A.C. (Bahia Univ., Salvador (Brazil)). 1977. 68p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700658/JAW.

Determination of the carbon and oxygen isotopic compositions were made on approximately 100 samples of Late Precambrian metasedimentary rocks of the Rio Pardo Group from Southern Bahia. The results obtained show that carbon varies from δ/sup 13/=C=5,73 per mille to δ/sup 13/C=+9,00 per mille, and oxygen from δ/sup 18/O=-1,87 per mille to δ/sup 18/O=-19,67 per mille relative to PBD. The interpretations lead to some conclusions which confirm the validity the isotopic technique as auxiliary instrument in the study of geological problems. These include: 1) the evidence of a marine transgression during the Camaca sedimentation; 2) the probability that the dolomitic metalimestones of the Agua Preta formation belong to the Serra do Paraiso formation; 3) the assignment of the dolomitic metalismestones, which occur in Itiroro and which had been previously grouped with the crystalline basement rocks, to the Serra do Paraiso formation; 4) the removal of the marble from Serra do Paraiso formation and re-signment to the basement rocks, and finally; 5) the sedimentary evolution of the Rio Pardo Group from a typical fresh-water to a marine environment.

6100 **(INIS-BR—900) Electronic excitation of some silicium compounds in the vacuum ultravi olet region.** Rocco, M.L.M. (Rio de Janeiro Univ. (Brazil). Inst. de Quimica). 1986. 115p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700660/JAW.

Angle-resolved electron energy-loss spectra have been measured for the tetramethylsilane, trimethylchlorosilane and dimethyldichloresilane molecules in the 5 - 300 eV energy range. The spectra have been obtained at 1 KeV incident energy, with an energy resolution of about 0.5 eV (valense region) and 0.8 eV (inner-shell region). Both the valence and core-level excitation bands can be as associated to transitions to Rydber and valence states. No dipole-allowed transition has been observed in the spectra measured in the angular range of 1 to 9 degrees (valence region) and 3 to 7 degrees (inner-shell region).

6101 (INIS-SU—429, pp 50-51) **Application of extraction of element benzoylpyrazolonates by aliphatic alcohol melts and their X-ray-radiometric determination.** Zhuk, S.V.; Prokhorova, N.G.; Makarov, N.V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Mineral'nogo Syr'ya, Moscow, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6102 (INIS-SU—429, pp 3-4) **Spectrophotometric determination of zirconium and hafnium with 2-hydroxycyclopentadienon.** Bogatyr', N.I.; Litvinenko, V.A. (Kievskij Politekhnicheskij Inst., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6103 (INIS-SU—429, pp 20) **Application of derivative absorption spectra of rare earth and uranium(4) ions for analysis.** Mishchenko, V.T.; Poluehktov, N.S.; Shilova, L.P.; Aleksandrova, N.N.; Perfil'ev, V.A. (AN Ukrainskoj SSR, Odessa. Fiziko-Khimicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6104 (INIS-SU—429, pp 29-30) **Comparison of organic reagents for choice of optimal procedure of Al and In photometric determination.** Pilipenko, A.T.; Bernik, N.P. 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

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6152 (INIS-SU—429, pp 62-63) **Interligand exchange in organic phase and its use in extraction-photometric analysis of multicomponent systems.** Per'kov, I.G.; Drozd, A.V.; Massud, M. (Khar'kovskij Gosudarstvennyj Univ., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

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6154 (INIS-SU—429, pp 72-73) **Thermodynamic calculation of rare earth element separation optimum conditions by the method of homogeneous precipitation in oxalate form.** Fishtik, I.F.; Povar, I.G.; Vataman, I.I. (AN Moldavskoj SSR, Kishinev. Inst. Khimii). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

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6155 (INIS-SU—429) **2. Republic conference on analytical chemistry. Summaries of reports.** (AN Ukrainskoj SSR, Kiev. Nauchnyj Sovet po Probleme Analiticheskaya Khimiya; AN Ukrainskoj SSR, Kiev. Inst. Kolloidnoj Khimii i Khimii Vody; Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya Ukrainskoj SSR, Kiev; Kievskij Gosudarstvennyj Univ. (Ukrainian SSR); Uzhgorodskij Gosudarstvennyj Univ. (Ukrainian SSR); Vsesoyuznoe Khimicheskoe Obshchestvo, Moscow (USSR)). 1985. 253p. (In Russian). (CONF-8510473—Summs.). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW.

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6156 (JINR—R-6-86-228) **Calculation of the deposition temperature in thermochromatography.** Kim U Jin; Zvara, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700529/JAW.

For radiochemical analysis and identification of nuclear reaction products using thermochromatographic method by analysis of the basic equation of the ideal linear thermochromatography for columns with constant temperature gradient, there were deduced some approximate analytical formulae which discribe the dependence of the deposition temperature, T/sub A/ (maximum of the thermochromatographic peak) on the enthalpy of adsorption, ΔH/sub a//sup 0/, and on experimental parameters, the dependence of the entropy of adsorption on temperature is allowed for. The formulae are valid within broad range of values of the variables, comparison with the numerical solution of the basic equation demonstrates, that their accuracy is better than that of experimental T/sub A/'s. Formula for calculating ΔH/sub a//sup 0/ as a function of T/sub A/ and the experimental conditions is obtained as well. 6 refs.; 2 figs.; 1 tab.

6157 (JINR—R-14-86-775) **Determination of chemical composition of coal ash on the basis of the measurement of proton-induced characteristic X-ray radiation.** Il'khamov, R.A.; Li Zen Kho; Osetinskij, G.M.; Pajek, M.; Khalbaev, I.; Khushmurodov, Sh.Kh.; Shandrik, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700555/JAW.

The method of determination of chemical composition of coal ash samples taken at one of the electric power station is reported. The method is based on the measurement of characteristic X-ray radiation after irradiation of the samples with protons from Van de Graaf accelerator. Most advantageous is that one may simultaneously find the concentration of more than twenty elements with $15 \leqq Z \leqq 82$ within an accuracy of nx10/sup -5/%. The results obtained were compared with those obtained from the chemical analysis of the same samples. They were checked for the determination of chemical composition of geological standards (SP-2, SWT-13, etc). 11 refs.; 4 figs.; 3 tabs.

6158 (K/QT—107) **Chemical analysis of uranium compounds.** Jarabek, R.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1987. Contract AC05-84OT21400. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002539/JAW.

Research and development studies relating to gaseous diffusion plants require expertise in the analysis of uranium and its compounds. Synthesis of these compounds along with subsequent use necessitates a means of identification in addition to X-ray diffraction patterns normally obtained. Analyses for fluoride, nickel, and iron have been developed to supplement the analysis for U^{+4} and U total previously developed. The fluoride is determined by pyrolysis, with subsequent acid-base titration. Nickel is analyzed by precipitation with dimethylglyoxime following complexation of the uranium with citric acid. Iron is analyzed iodometrically following an ammonium hydroxide-ammonium carbonate separation process from the uranium. High precision and accuracy can be obtained on these procedures using low-cost, wet chemical methods. Expensive computerized equipment is not needed. Uranium compounds analyzed include UF_6, UO_2F_2, U_3O_8, and U_3F_8.

6159 (KFK—4299) **Stripping voltammetric assay of technetium traces with the aid of a TOPO modified glassy carbon electrode.** Torres Llosa, J.M.; Ruf, H.; Schorb, K.; Ache, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Aug 1987. 17p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750548/JAW.

A stripping voltammetric procedure for the analytical assay of technetium traces is described, in which enrichment of the radioelement is not achieved by electrolysis, but by complex formation with tri-n-octylphosphineoxide (TOPO) covering the surface of a glassy carbon electrode. The deposition is best performed with 3 M HCl solutions. In a subsequent cathodic DP mode polarization starting from zero V, a distinct reduction peak appears at -350 mV (vs. Ag/AgCl) if pertechnetate is present in the solution. After 10 minutes of enrichment 1,8 x 10/sup -8/ moles of Tc per liter still furnish a signal which can be well utilized. A DP voltammetric stripping signal is also generated by Tc-IV with a peak potential more negative by about 50 mV as compared with the Tc-VII signal. On account of the too narrow peak distance simultaneous precise recording of Tc-IV and Tc-VII is not easily possible. Uranium amounts surpassing those of the technetium present interfere. Since only a few elements react with TOPO in strongly acid media, the determination is rather selective.

6160 (Y/DK—522) **Accurate sorption isotherm acquisition by computer-aided gravimetric methods.** Thompson, K.A.; Fuller, E.L. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 29 Aug 1986. Contract AC05-84OS21400. 19p. (CONF-861019—27). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001819/JAW.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

Sorption isotherms are routinely acquired for surface area and porosity measurements, but often have a minimum number of sample points to facilitate quick determinations. When more detailed analysis is required for accurate determinations, to measure kinetics or to compare to new theories, more care is needed to reduce errors and to increase acquisition points. The gravimetric method has the versatility that it measures directly the mass, pressure, and temperature all independently and has direct accountability, that is, not dependent upon previous measurements (compared to the volumetric method). The need for more data points necessitates computer control of the data acquisition. For this purpose, a high-vacuum microbalance was designed and interfaced with an LSI 11/23 minicomputer. All aspects of the data acquisition are controlled by the computer, including pressure settings, mass readings and storage, and temperature control (and filling the bath, if

required). The system was tested by initially acquiring sorption isotherms for a commercially available silica supported alumina catalyst, A6S. Nitrogen and argon were used as adsorbates, using both gases in condensed form for the sample bath. Although nitrogen at 77°K has become the favored standard, argon at 88°K would seem to have some advantages, particularly being monoatomic and having a smaller quadrupole dipole. Other comparisons are given, and the merits of the automated high-vacuum microbalance become quite evident when nonroutine, detailed exploratory studies are required.

6161 **Mechanism of solute retention in supercritical fluid chromatography.** Yonker, C.R.; Wright, R.W.; Frye, S.L.; Smith, R.D. (Chemical Methods and Separations Group, Chemical Technology Dept., Pacific Northwest Lab., Battelle Memorial Institute, Richland, WA 99352). pp 172-188 of Supercritical fluids: Chemical and engineering principles and applications. Squires, T.G.; Paulaitis, M.E. Washington, DC; American Chemical Society (1987). (CONF-850942—). Contract AC06-76RL01830.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

The complicated dependence of retention in supercritical fluid chromatography as a function of temperature and pressure is examined. Simple thermodynamic relationships are derived and discussed which allow the calculation of the slope of solute retention as a function of both temperature and pressure. These models are compared to experimental data obtained over a wide range of temperatures and pressures. The model was also compared to chromatographic retention data for solutes in n-pentane and CO/sub 2/ as the fluid mobile phase and was seen to fit the data well.

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REFER ALSO TO CITATION(S) 5391, 5501, 5567, 5645, 6007, 6043, 6058, 6141, 6142, 6143, 6144, 6145, 6146, 6147, 6148, 6149, 6150, 6151, 6434, 6900

6162 **(CONF-870594—3) Excess thermodynamic properties of aqueous electrolytes to high temperatures and pressures.** Simonson, J.M.; Holmes, H.F.; Mesmer, R.E.; Busey, R.H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001768/JAW.

From International conference on thermodynamics of aqueous systems with industrial applications; Warrenton, VA, USA (10 May 1987).

Excess thermodynamic properties have been obtained for a number of pure and mixed aqueous electrolyte solutions at high temperatures and pressures through measurements of isopiestic ratios and enthalpies of dilution. The equipment and techniques used in these studies are described. Representations of the experimental results used to correlate measured values and calculate other thermodynamic quantities from the experimental results are described. Isopiestic ratios relative to NaCl(aq) standard solutions have been measured for a number of classes of electrolytes to 250°C, including the alkali and alkaline earth chlorides, alkali sulfates and bisulfates, and a number of mixed electrolyte solutions. Flow calorimetric measurements of dilution enthalpies have been made as functions of temperature and pressure to 400°C and 400 bars on NaCl(aq), $CaCl_2$(aq) and NaOH(aq). Results extend across the temperature range of transition between strong electrolyte behavior, as indicated by results at low temperatures, and ion association at high temperatures, as has been indicated in studies of electrical conductance. Modeling of the experimental results obtained in this program with other available data has given consistent sets of values of excess thermodynamic properties for a number of aqueous electrolyte systems. 47 refs., 8 figs., 2 tabs.

6163 **(DOE/ER/13619—2) Resonance Raman and photophysical studies of polypyridine complexes of ruthenium: Progress report for period March 1, 1987-February 28, 1988.** Kincaid, J.R. (Marquette Univ., Milwaukee, WI (USA). Dept. of Chemistry). 25 Oct 1987. Contract FG02-86ER13619. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002366/JAW.

The program is divided into two major projects. The first, involving the parent compound, $Ru(2,2'\text{-bipyridine})_3^{2+}$, deals with the influence of the forms of the ground and excited state vibrational modes on the nonradiative decay rates. In order to make progress in this area, carefully conducted normal mode calculations are required for the ground and excited state species. Such a calculation for the ground state species has been completed. Following acquisition of excited state resonance Raman spectra, the calculation for this species is in progress. The second major area of interest is the investigation of structurally modified derivatives of $Ru(2,2'\text{-bipyridine})_3^{2+}$. A number of series of mixed-ligand complexes have been prepared and their ground state Raman spectra obtained.

6164 (INIS-SU—429, pp 8) **Mutual effect of cation and nonionic surfactants on photometric reactions of metal ions with bromopyrogallol red.** Gorenshtejn, L.I.; Tananajko, M.M. 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6165 (INIS-SU—429, pp 16-17) **Kinetic factors of different-ligand complexing.** Lukachina, V.V.; Pilipenko, A.T.; Spasenova, L.N. 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6166 (INIS-SU—429, pp 34) **Correlations between rare earth complexes stability and quantum-mechanic characteristics of their ions.** Poluehktov, N.S.; Meshkova, S.B.; Danilkovich, M.M. (AN Ukrainskoj SSR, Odessa. Fiziko-Khimicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6167 (INIS-SU—429, pp 39-40) **Bimetallic complexes with unithiol and 8-mercaptoquinoline.** Usatenko, Yu.I.; Suprunovich, V.I.; Danilenko, E.F.; Golovko, L.A. (Dnepropetrovskij Khimiko-Tekhnologicheskij Inst., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6168 (INIS-SU—429, pp 48) **Holmium coprecipitation by zinc hydroxide (basic salts).** Gavrilyuk, A.I.; Prokhurskaya, O.I. (L'vovskij Gosudarstvennyj Univ., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6169 (INIS-SU—429, pp 67-68) **Study of solubility and complexing in zirconium hydroxide-fulvic acids system and role of these processes in zirconium migration in natural waters.** Samchuk, A.I.; Sushchik, Yu.Ya.; Kokot, T.K. (AN Ukrainskoj SSR, Kiev. Inst. Geokhimii i Fiziki Mineralov). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6170 (INIS-SU—429, pp 78) **Luminescent determination of some drugs using lanthanide complexes.** Bel'tyukova, S.V.; Kravchenko, T.B.; Poluehktov, N.S.; Tochidlovskaya, T.L. (AN Ukrainskoj SSR, Odessa. Fiziko-Khimicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6171 (INIS-SU—429, pp 91-92) **Neodymium luminescence in complexes with coloured ligands.** Poluehktov, N.S.; Meshkova, S.B.; Rusakova, N.V. (AN Ukrainskoj SSR, Odessa. Fiziko-Khimicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6172 (INIS-SU—429, pp 92) **Luminescence of ytterbium(3) complexes with some heterocyclic azo compounds and surfactants.** Poluehktov, N.S.; Meshkova, S.B.; Korovin, Yu.V. (AN Ukrainskoj SSR, Odessa. Fiziko-Khimicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6173 (INIS-SU—429, pp 93) **Study and analytical use of lanthanide complexes with cyclic β-diketones.** Poluehktov, N.S.; Gerasimenko, G.I.; Tishchenko, M.A.; Ul'yanova, T.M. (AN Ukrainskoj SSR, Kiev. Fiziko-Tekhnicheskij Inst.; Odesskij Politekhnicheskij Inst., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6174 (INIS-SU—429, pp 95) **Fluorinated β-dicarbonyl compounds as reagents for luminescence determination of lanthanide microamounts.** Tishchenko, M.A.; Tishchenko, V.V.; Shendrik, V.P.; Melent'eva, E.V.; Khafagi, Z.A. (Odesskij Politekhnicheskij Inst., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6175 (INIS-SU—429, pp 96-97) **Complexing of ruthenium nitroso compounds with dimercaptothiopyrones in material analysis.** Fedash, T.G.; Arishkevich, A.M.; Pichkov, V.N.; Kutsenko, L.M. (Dnepropetrovskij Metallurgicheskij Inst., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6176 (INIS-SU—429, pp 101) **Comparative study and analytical application of dimercaptothiopyrones in electrochemical and spectrophotometric methods of analysis.** Arishkevich, A.M.; Kutsenko, L.M.; Tysyachnyj, V.P.; Barkalov, V.S.; Pojda, L.D.; Fedash, T.G.; Voloshina, V.V.; Charun, I.E. (Dnepropetrovskij Metallurgicheskij Inst., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6177 (INIS-SU—429, pp 114) **Polarographic investigation of europium ion reduction on mercury-droping electrode in haloid salt aqueous solutions.** Levitskaya, G.D.; Ture, M.F.; Lata, L.P. (L'vovskij Gosudarstvennyj Univ., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6178 (INIS-SU—429, pp 128-129) **Catalytic currents of chlorate ion in molybdenum(6) solutions in the presence of sulfosalicylic acid and resorcinol.** Chikryzova, E.G.; Kiriyak, L.G. (AN Moldavskoj SSR, Kishinev. Inst. Khimii). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6179 (INIS-SU—429, pp 136-137) **Selective sorption of metals on silica powders chemically modified with nitrogen-containing ligands.** Glushchenko, L.V.; Lishko, T.P.; Zajtsev, V.N.; Trofimchuk, A.K. 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6180 (INIS-SU—429, pp 137-138) **Investigation of zirconium(4) complexes with mandelic and lactic acids.** Gnatyshin, O.M.; Popovich, M.I. (L'vovskij Gosudarstvennyj Univ., Ukrainian SSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6181 (INIS-SU—429, pp 166) **Sorption of ruthenium, osmium ions and their complexes with 1.10-phenanthroline on chemically modified silica.** Fadeeva, V.I.; Zmievskaya, I.R.; Kudryavtsev, G.V.; Tikhomirova, T.I.; Runov, V.K. (Moskovskij Gosudarstvennyj Univ., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6182 (INIS-SU—429, pp 190-191) **Study of fragment change of composition of heteropoly compounds.** Pilipenko, A.T.; Trachevskij, V.V.; Trokhimenko, V.M. 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6183 (INIS-SU—429, pp 191-192) **Study of reduction of heteropoly compounds in the presence of basic dyes.** Pilipenko, A.T.; Trachevskij, V.V.; Trakhimenko, O.M. 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6184 (INIS-SU—429, pp 193-194) **Molybdenum and tungsten complexes with substituted diazonaphthols.** Trachevskij, V.V.; Kalibabchuk, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Kolloidnoj Khimii i Khimii Vody; Ukrainskij Poligraficheskij Inst., L'vov). 1985. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780030/JAW. (CONF-8510473—Summs.).

From 2. republic conference on analytical chemistry; Uzhgorod, Ukrainian SSR (1 Oct 1985).

6185 **(LBL—23955) The structure of benzene adsorbed on Pd(111): A dynamical LEED [Low-Energy Electron Diffraction] study.** Ohtani, H.; Van Hove, M.A.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 7p. (CONF-871125—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002234/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

Coadsorption of benzene and CO on Pd(111) yields a new surface periodicity with (3 x 3) unit cell (relative to the (1 x 1) substrate periodicity). HREELS (High-Resolution Electron Energy Loss Spectroscopy) and TDS (Thermal Desorption Spectroscopy) imply that one benzene molecule and two CO molecules are adsorbed associatively over hollow sites in each (3 x 3) unit cell. This coadsorbed structure, Pd(111)-(3 x 3)-C_6H_6 + 2CO, was analyzed with dynamical calculations of LEED intensities to yield detailed bond lengths information. In this structure, both benzene and CO are adsorbed over fcc-type hollow sites in a close-packed lattice. The benzene ring skeleton is found to be nearly indistinguishable from the gas phase structure on Pd(111) surface. The molecular structure of benzene on Pd(111) obtained is compared with previously studied benzene structures on Rh(111) and Pt(111). In all cases, benzene is coadsorbed with CO to produce well-ordered superlattice. 18 refs., 1 fig., 1 tab.

6186 **(LBL—23992) Synthesis and structural characterization of transition metal oxo (hydroxo) siloxides: Reactions of transition metal dialkylamides with diphenylsilanediol.** Rutherford, N.M. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 231p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88002081/JAW.

A systematic approach to the synthesis of molecular metallosiloxanes was investigated via the reaction of transition metal dialkylamides with diphenylsilanediol. Reaction of $Ti(NEt_2)_4$ with $Ph_2Si(OH)_2$ yielded the molecular complexes $[H_2NEt_2]_2[Ti_4O_2(OH)_2(OSiPh_2O)_6]$ and $[H_2NEt_2]_2[Ti_4O_2(OH)_2(OSiPh_2O)_6((OSiPh_2)_2O)]$. Reaction of the vanadium(V) dialkylamide, $OV(NEt_2)_3$ with $Ph_2Si(OH)_2$ afforded $[H_2NEt_2]_2[V_2O_4(OSiPh_2O)_2]$ and $[H_2NEt_2][VO_2(OSiPh_2)_3O)]$, a bridged dimer and a chelated monomer, respectively. Reaction of the vanadium(IV) dialkylamide $V(NEt_2)_4$ gave $[Li(THF)_2]_2[VO((OSiPh_2)_2O)_2]$. Infrared studies on the new metallosiloxanes allowed differentiation between mononuclear and polynuclear structures. An Si-O-Si infrared band revealed the presence of the homocondensed form of the ligand, while the position of the band was indicative of the extent of ligand polymerization. The solution molar conductivities of all of the complexes in non-coordinating solvents were anomalously low. Acidification and conversion to tetraalkylammonium derivatives resulted in the expected conductivities for 2:1 electrolytes. Silicon-29 MASNMR spectra of the metallosiloxanes revealed a correlation between the average M-O-Si (M = Si, T, V) bond angle and the chemical shift. Reaction of $Ph_2Si(OH)_2$ with dialkylamides of Cr, Mo, Zr, Si and Al, and with the trimethylsilylamides of Fe and Co gave polymeric products containing M-O-Si structural units.

6187 **(LBL—24003) Optical properties of tetravalent uranium in the solid state.** Edelstein, N. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 8p. (CONF-870443—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002271/JAW.

From 2. international conference on the basic and applied chemistry of f-transition (lanthanides and actinides) and related elements; Lisbon, Portugal (6 Apr 1987).

The optical spectra are fit to the parameters of a phenomenological Hamiltonian from which a calculated spectrum is obtained. The goodness of fit is determined by the value of σ (cm^{-1}), the rms deviation. The σ and crystal field are tabulated for U^{4+} in various host crystals, Pr^{3+} or Nd^{3+} in various crystals, and the free ion U^{4+}. The rms deviation σ for the U^{4+} compounds is much worse on the average than for the Pr/Nd examples. There appears to be a correlation between a poor fit and a large σ, and a large crystal field. 28 refs., 1 tab. (DLC)

6188 **(LBL—24029) A temperature-programmed desorption study of subsurface diffusion in high surface area catalysts.** Leary, K.J. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88002277/JAW.

Temperature-programmed desorption (TPD) and reduction (TPR) were used to show that small atoms such as carbon and oxygen moved relatively easily between surface and subsurface layers of Mo_2C catalysts. It was shown that hydrogen penetrated into subsurface absorption sites of palladium. The presence of these atoms in layers just below the surface could affect the way various adsorbates bind to and react on the surface. During heating, oxygen moved between the surface and subsurface layers of the catalyst. This movement, referred to as subsurface diffusion, produced a high temperature peak in the TPR spectrum. It was also shown, with the aid of a numerical model, that subsurface diffusion produced a high temperature peak in the TPD spectrum of hydrogen on a Pd/SiO_2 catalyst. 56 refs., 34 figs.

6189 **(LBL—24110) The coordination chemistry of divalent bis(pentamethylcyclopentadienyl)lanthanide complexes with non-classical ligands.** Burns, C.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 308p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88002687/JAW.

Divalent complexes $(Me_5C_5)_2M$ (M = Eu, Sm, Yb, Ca, Sr, and Ba) have been isolated free of coordinating Lewis bases. These complexes have a "bent-sandwich" geometry. The bonding in the compounds is ionic. Divalent lanthanide and alkaline earth cations of similar ionic radii demonstrate similar coordination chemistry with simple Lewis bases. Isolation of the base-free species allows the synthesis of coordination compounds of weak bases, such as electron-rich olefins and acetylenes. The complexes $(Me_5C_5)_2Yb(\mu\text{-}C_2H_4)Pt(PPh_3)_2$ and $(Me_5C_5)_2(eta^2\text{-MeC}$ identical to CMe) is eta^2-coordinated to the lanthanide. Ethylene is rapidly polymerized by $(Me_5C_5)_2Yb$, and methylallene is catalytically isomerized to 2-butyne. Fluoro-olefins and -arenes undergo reduction followed by fluoride abstraction to give the mixed-valence compound $[(Me_5C_5)_2Yb]_2(\mu\text{-F})$, which is converted thermally to the tetranuclear species $(Me_5C_5)_3Yb_4(\mu\text{-F})_4$. The reaction of $(Me_5C_5)_2Yb$ with polar compounds such as $(Me_5C_5)BeMe$ and BH_3 . PMe_3 results in the formation of coordination compounds. Zinc alkyl and aryl compounds are reduced to yield zincate complexes of the formula $(Me_5C_5)_2Yb(\mu\text{-}R)_2ZnR$. The trimethylzincate compound displays symmetrically bridging methyl groups, while in the phenyl analog, the bridging geometry is markedly unsymmetric. Sterically demanding polar molecules such as carboranes react with $(Me_5C_5)_2Yb$ to form inclusion compounds, with no close host-guest contacts in the solid state.

6190 **(LBL—24153) Bis(pentamethylcyclopentadienyl)ytterbium: Reactions with organic compounds and related molecules.** Berg, D.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 235p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88002706/JAW.

The complex $Yb(C_5Me_5)_2(OEt_2)$ acts as a reducing agent towards nitrogenous bases with reduction potentials of ca. -2.0 V or less, forming paramagnetic coordination compounds. Magnetic susceptibility measurements have been used to identify four different electronic structural types. The reaction of $Yb(C_5Me_5)_2(L)$/sub n/ (L = Et_2O, n = 1; L = NH_3, n = 2) with organic dichalcogenides (REER, where R = alkyl or aryl and E = 0, S, Se, Te) allows preparation of $Yb(C_5Me_5)_2(ER)(L)$ complexes. The crystal structures were determined. The reactions of $Yb(C_5Me_5)_2(ER)(L)$ with Me_3Al produces $[Yb(C_5Me_5)_2(AlMe_4)]_2$ for ER = $OSiMe_3$ or TeC_6H_5 and $[Yb(C_5Me_5)_2(AlMe_3)(ER)]_2$ when ER = $OCMe_3$, SC_6H_5, S-p-C_7H_7 or SeC_6H_5. $Yb(C_5Me_5)_2(OEt_2)$ reacts with REH_2 (E = N, P) to form coordination compounds, $Yb(C_5Me_5)_2(REH_2)$ when REH_2 is less acidic than C_5Me_5H (pK/sub a/ = 26.5). More acidic amines and phosphines protonate $C_5Me_5^-$ with formation of insoluble one-ring products.

6191 (UCRL—15966) Synthesis of heavy metal organometallic compounds: Final report. Bell, J.P.; Norem, N.T.; Margrave, J.L. (Rice Univ., Houston, TX (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002449/JAW.

Goal was the preparation of heavy metal organometallic compounds, especially gold compounds, which were reasonably stable and reasonably volatile at room temperature. Our approach to the problem via gold atom reactions at low temperatures led to the successful preparation of two new compounds: bis(trifluoromethyl)gold-μ-bromide dimer and bis(trifluoromethyl)gold-μ-iodide dimer. Efforts to prepare hexafluoroacetylacetonates, ethoxides, and PF_3 coordination compounds of gold were unsuccessful.

6192 Analysis with electron microscope of multielement samples using pure element standards. King, W.E. (to Dept. of Energy, Washington, DC). US Patent 4,697,080. 29 Sep 1987. Filed date 6 Jan 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described for determining the composition of a multielement sample containing predetermined elemental components comprising the steps of providing single component samples of each component having at least two thicknesses, directing a beam of electrons at each sample to generate characteristic x-ray intensities, simultaneously measuring the x-ray intensities and beam dosage associated with the beam of electrons, exposing the multicomponent sample to the beam of electrons to generate characteristic x-ray intensities for each component, and measuring the individual intensities to determine the relative concentration of each in the above equation.

6193 Molecular dynamics of the water liquid-vapor interface. Wilson, M.A.; Pohorille, A.; Pratt, L.R. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **91**: No. 19, 4873-4878(10 Sep 1987).

The results of molecular dynamics calculations on the equilibrium interface between liquid water and its vapor at 325 K are presented. For the TIP4P model of water intermolecular pair potentials, the average surface dipole density points from the vapor to the liquid. The most common orientations of water molecules have the C/sub 2nu/ molecular axis roughly parallel to the interface. The distributions are quite broad and therefore compatible with the intermolecular correlations characteristic of bulk liquid water. All near-neighbor pairs in the outermost interfacial layers are hydrogen bonded according to the common definition adopted here. The orientational preferences of water molecules near a free surface differ from those near rigidly planar walls which can be interpreted in terms of patterns found in hexagonal ice 1. The mean electric field in the interfacial region is parallel to the mean polarization which indicates that attention cannot be limited to dipolar charge distributions in macroscopic descriptions of the electrical properties of this interface. The value of the surface tension obtained is 132 +/- 46 dyn/cm, significantly different from the value for experimental water of 68 dyn/cm at 325 K.

6194 Electron excitation dynamics, localization, and solvation in small clusters. Landman, U.; Barnett, R.N.; Cleveland, C.L.; Scharf, D.; Jortner, J. (Georgia Institute of Technology, Atlanta). *Journal of Physical Chemistry;* **91**: No. 19, 4890-4899(10 Sep 1987). Contract FG05-86ER45234.

The energetics and dynamics of electronically excited rare-gas clusters and modes of electron attachment and solvation in alkali halide clusters and in water clusters are investigated by classical and quantum path-integral molecular dynamics techniques. The authors demonstrate the versatility and degree of spatial and temporal detail afforded by computer simulations and the new avenues which such studies open for studies of physical and chemical phenomena, not accessible by other modes of investigation.

6195 Electrical conductivity and electronic properties of liquid silicon. Allen, P.B.; Broughton, J.Q. (State Univ. of New York, Stony Brook). *Journal of Physical Chemistry;* **91**: No. 19, 4964-4970(10 Sep 1987). Contract FG02-85ER45218.

The electronic properties of liquid silicon have been calculated by coupling molecular dynamics and Slater-Koster (empirical LCAO) methods. Atomic configurations of liquid silicon at 2010 K were generated by molecular dynamics in which the interparticle potential was assumed to be of Stillinger-Weber form. Carefully parametrized nonorthogonal tight binding parameters were then used to calculate the electronic eigenstates of the system. From these the conductivity σ(omega) is evaluated without further approximation, using the Kubo formula.

6196 Evidence from a hot atom experiment for the silylsilylene-to-disilene rearrangement: $SiH_3SiH: \rightarrow SiH_2{=}SiH_2$. Gaspar, P.P.; Boo, B.H.; Svoboda, D.L. (Washington Univ., St. Louis, MO). *Journal of Physical Chemistry;* **91**: No. 19, 5011-5013(10 Sep 1987).

Adducts of disilene ($SiH_2{=}SiH_2$) and silylsilylene (SiH_3SiH:) to butadiene have been found, in addition to the previously reported products from the reactions of recoiling silicon atoms in gaseous mixtures of phosphine (PH_3), butadiene ($C\text{-}H_2{=}CH\text{-}CH{=}CH_2$), and silane ($SiH_4$). The change in yields when neon moderator is present - the yield of the silylsilylene adduct increases while that of the disilene adduct decreases - is in accord with the formation of disilene via a silylsilylene intermediate. This is strong evidence for the rearrangement of silylsilylene to disilene: $SiH_3SiH: \rightarrow SiH_2{=}SiH_2$.

6197 Relationship between excitation transport and fluorescence depolarization in two- and three-dimensional disordered systems: effect of residual polarization. Anfinrud, P.A.; Struve, W.S. (Iowa State Univ., Ames). *Journal of Physical Chemistry;* **91**: No. 19, 5058-5060(10 Sep 1987). Contract W-7405-ENG-82.

Fluorescence depolarization experiments in electronic excitation transport are frequently analyzed under the assumption that fluorescence becomes completely depolarized after a single excitation hop from the initially excited molecule. The authors review Galanin's calculation of the residual polarization P_1 after a single hop in a random 3-dimensional system, and we extend this calculation to 2-dimensional transport among molecules adsorbed on a flat surface with transition moments randomly oriented on a cone of half-angle theta* from the surface normal. To test the effects of neglecting the residual polarization in solution transport, we generated anisotropic model fluorescence profiles using current transport theory coupled with a realistic simulation of residual polarization. These profiles were then deconvoluted under the assumption that residual polarization is absent. The resulting discrepancies are extremely small and are barely detectable under the best current photon-counting statistics recently used by us. The magnitude of the residual polarization in 2-dimensional transport depends on the adsorption angle theta* but is comparable to that in 3-dimensional transport.

6198 Effect of trace impurities on a bifurcation structure in the Belousov-Zhabotinskii reaction and preparation of high-purity malonic acid. Noszticzius, Z.; McCormick, W.D.; Swinney, H.L. (Univ. of Texas, Austin). *Journal of Physical Chemistry;* **91**: No. 19, 5129-5134(10 Sep 1987).

The authors have found that impurities on the ppm level in malonic acid are sufficient to alter dramatically a sequence of bifurcations in the Belousov-Zhabotinskii (BZ) reaction. Samples of malonic acid from 15 vendors were tested, and each was found in contain one or more of the following impurities that affect the reaction dynamics: iron, paraformaldehyde, ethanol, methanol, ethyl ester, and methyl ester. The authors describe a straightforward procedure for purifying malonic acid. Reproducible bifurcation structures can only be observed with the highly purified malonic acid. Measurements with varying amounts of the above-mentioned impurities added to purified malonic acid show the striking effect of impurities on the dynamics of the BZ reaction.

6199 Comparison of models for the free-free Gaunt factor at low temperatures and frequencies. Collins, L.A.; Merts, A.L. (Group T-4 Los Alamos National Lab., Los Alamos, NM 87545). pp 57-76 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The authors perform calculations for the free-free Gaunt factor at electron and photon energies below 1 Ry in the dipole approximation to the radiation field for a variety of representations of the scattering potential. They consider the static-exchange, static-exchange + model polarization, model exchange, and static models. Within each model, the resulting Schrodinger equation is solved exactly using a linear algebraic prescription. The rare gas and alkali systems are investigated. The authors find great sensitivity to the models for energies below four electron volts (4 eV). Above this energy, the Gaunt factors for the various models come into better agreement.

6200 **Application of solvatochromic probes to supercritical and mixed fluid solvents.** Frye, S.L.; Yonker, C.R.; Kalkwarf, D.R.; Smith, R.D. (Chemical Methods and Separations Group, Chemical Technology Dept., Pacific Northwest Lab., Battelle Memorial Institute, Richland, WA 99352). pp 29-41 of Supercritical fluids: Chemical and engineering principles and applications. Squires, T.G.; Paulaitis, M.E. Washington, DC; American Chemical Society (1987). (CONF-850942—). Contract AC06-76RL01830.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Changes of the polarity/polarizability of supercritical CO/sub 2/, N/sub 2/O, Freon-13, NH/sub 3/, and CO/sub 2//methanol mixtures, were measured by observing the shift of the UV absorption of 2-nitroanisole as a function of temperature and pressure. The polarities of the supercritical fluid solvents are compared to those of liquid solvents through use of the Kamlet-Taft π/sup */ polarity scale. In pure supercritical solvents the polarity was found to correlate primarily with density. The data for CO/sub 2/ indicate that a change in the cybotatic region occurs at a fluid density of —0.3 g/cm/sup 3/. Adding methanol as a modifer to supercritical CO/sub 2/ gradually increases the polarity of the solvent and in solutions with over 10% methanol the composition of the cybotatic region appears to be enriched in methanol (compared to the bulk composition).

6201 **Mechanism of radical-radical reactions: The reaction of atomic hydrogen with the formyl radical.** Harding, L.B.; Wagner, A.F. (Chemistry Div., Argonne National Lab., Argonne, IL). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **31**: No. 2, 65(Apr 1986). (CONF-860425—). Contract W-31-109-ENG-38.

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

The addition and abstraction reaction pathways on the potential energy surface for H+HCO have been characterized by an ab initio four electron, complete active space, self-consistent field electronic structure calculation. The elimination pathway to go from the excited adduct H/sub 2/CO to products H/sub 2/+CO has already been characterized by others. All this information is used in variational transition state theory and RRKM calculations to calculate a rate constant as a function of temperature and pressure. The room temperature value agrees with the lowest of three experimental measurements. The results indicate that abstraction is the dominant process.

6202 **Thermal and state-selected rate constant calculations for O(/sup 3/P) + H/sub 2/ → OH + H and isotopic analogs.** Truhlar, D.G.; Garrett, B.C. (Dept. of Chemistry, Univ. of Minnesota, Minneapolis, MN). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **31**: No. 2, 73(Apr 1986). (CONF-860425—).

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

The authors use ab initio potential energy surfaces, including new parametrizations of the bending potentials for the two lowest electronic states, to calculate the rate constants for the reaction O(/sup 3/P) + H/sub 2/. The dynamics calculations are based on variational transition state theory with multidimensional semiclassical tunneling corrections. They present results for the temperature range 250-2400K. In general the calculated rate constants for the thermal reaction are in excellent agreement with available experiments. They also calculate the enhancement effect for exciting H/sub 2/ to the first excited vibrational state. For the reaction of vibrationally excited H/sub 2/ the rate constant is based on a dynamical bottleneck of 7.2 kcal/mol, as compared to a saddle point value of 12.6 kcal/mol, and it is in good agreement with experiment. The good agreement of theory and experiment for the excited state rate provides a dramatic demonstration of the reality of dynamical bottlenecks at locations far from the saddle point.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 5599, 5636, 5747, 5748, 5809, 6079

6203 (SERI/CP—233-2959, pp 201) **Spectroelectrochemical measurements of polyaniline.** Feldberg, S.W.; Mikesell, P.C.; Yoon, H.J.; Gottefeld, S. (Brookhaven National Lab., Upton, NY). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Preliminary work examined the spectroelectrochemical properties of polypyrrole. Short term instability of this compound precludes obtaining precise and reproducible data. Polyaniline, however, seems to exhibit desired virtues as well as compatibility with water. Although polyaniline is experimentally user friendly its behavior is nonetheless very similar to that of polypyrrole, polyacetylene and polyphenylene which are all electronically conducting polymers. Thus, an underlying presumption of this work is that the phenomena associated with these polymers are general and fundamental, e.g.: 1) The notion that there are two kinds of charge - faradaic charge, responsible for the switching between the conducting and insulating states of the polymer, and capacitive charge, which simply maintains electrostatic equilibrium between the metal-like conducting polymer and the bathing electrolyte; 2) the unique electrochemical irreversibility, common to all the aforementioned polymers, in which the cyclic voltammetric irreversibility appears to be scan-rate independent. Spectroelectrochemical data are consistent with the idea that there are indeed two kinds of charge. Ellipsometric studies provide direct measurement of film thickness. Oxidized (conducting) polyaniline exhibits a large imaginary part of the dielectric constant and a negative real part of the dielectric constant suggesting either metal-like behavior or a band-to-band transition. A general theory invoking the concept of N shaped free energy curves qualitatively explains the results and suggests that phase changes are involved in the switching phenomena.

4005 Photochemistry

REFER ALSO TO CITATION(S) 5654, 6076

6204 **(DOE/ER/13629—1) Photoinduced charge separation by polymer-bound chromophores: Progress report, September 1986-October 1987.** Webber, S.E. (Texas Univ., Austin (USA). Dept. of Chemistry). Oct 1987. Contract FG05-86ER13629. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002101/JAW.

Accomplishments during the first year are summarized in the following areas: preparation of photophysically active polymers, charge separation studies in polymers AACAA (A=hydrophilic group, C=aromatic chromophore), photoionization in polymers AACAA, and photon harvesting in ACACA polymers. (DLC)

6205 **Photoionization and photorecombination cross sections of non-hydrogenic states in plasmas.** Rozsnyai, B.F.; Jacobs, V.L. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA 94550). pp 264-292 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The authors use Hartree-Slater self-consistent-field wave functions to compute photoionization and photorecombination cross

sections and rates for partially ionized iron atoms, both in their isolated state and in a plasma environment. The calculated cross sections are fitted to analytic expressions so that the photoionization and recombination rates can be given in closed forms. The analytic representation satisfy the requirement that the oscillator-strength sums S/sub 0/, S/sub 1/ and S/sub 2/ must converge.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 5589, 5591, 5619, 5640, 5642, 5645, 5652, 5701, 6533

6206 **(INIS-BR—890) Polyvinyl chloride degradation by X-rays.** Sbampato, M.E. (Sao Paulo Univ. (Brazil). Inst. de Quimica). 1984. 173p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700656/JAW.

Degradation of film samples of pure PVC and comercial film (PVC + Polyacrylatis) with vacuum X-rays using the following techniques: infra-red, Raman, ultra violet and visible spectroscopies, eletronic paramagnetic resonance, X-rays difraction, percent measurement of transmitance and microanalysis was studied. (L.M.J.).

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 6259, 6506, 6514

6207 **(CONF-871038—2) Fluorine gettering by activated charcoal in a radiation environment.** Felker, L.K.; Toth, L.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001424/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

Activated charcoal is an effective gettering agent for the fluorine gas that is liberated in a radiation environment. Even though activated charcoal is a commonly used getter, little is known about the radiation stability of the fluorine-charcoal product. The product is stable in high gamma radiation fields and radiation enhances the capacity of the charcoal for the fluorine. The most useful application of this work is with the Molten Salt Reactor Experiment (MSRE) fuel salt because the radioactive components (fission products and actinides) cause radiolytic damage to the solid LiF-BeF_2-ZrF_4-UF_4 (64.5, 30.3, 5.0, 0.13 mol %, respectively) resulting in the liberation of fluorine gas. The maximum damage to the fuel salt by $\sim 3 \times 10^7$ R/h gamma radiation is approximately 2%, at which point the rate of recombination of fluorine with active metal sites within the salt lattice equals the rate of fluorine generation. The enhanced reactivity of the activated charcoal and radiation stability of the product ensures that the gettered fluorine will stay sequestered in the charcoal. 9 refs., 3 figs.

6208 **(IKMz—87-1) Institute for Nuclear Chemistry of the University of Mainz. Annual report 1986.** Weber, M. (comp.). (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie). 15 Jun 1987. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750539/JAW.

The report summarizes the points of main efforts of the Institute for Nuclear Chemistry during 1986: A. Rapid separations (thermochromatography of platinum elements; ICP source for the HELIOS mass separator; oxidation states of Lr; ionic radii of Lr/sup 3+/ and Md/sup 3+/; heats of hydration). B. Exotic nuclei and nuclear structure (lifetime of the 167 keV level of /sup 97/Sr; description of the K=3/2/sup +/ side band in /sup 99/Y with the IBF/PTQ model; pairing-free K/sup π/=1/sup +/-rotational bands in deformed odd/odd A $\simeq$ 100 nuclei; proton particle states in /sup 103,105/Rh; β-decay of the /sup 110,112/Rh isomers; β-decay half-life of /sup 130//sub 48/Cd and its importance for astrophysical r-process scenarios; alpha burning of /sup 14/O; β-decay half-lives of nuclei far from stability for astrophysical application; beta delayed neutron energy spectra for application in reactor physics). C. Nuclear fission (charge distribution in the reaction /sup 232/Th(n/sub R/,f); isomeric ratios and decay properties of /sup 96m,g/Y, /sup 97m,g/Y and /sup 134m,g/I). D. Heavy ion reactions (quasi fission in the reaction /sup 40/Ar + /sup 208/Pb near the Coulomb barrier; unusual excitation-energy distribution in quasi-fission reactions; competition of direct reactions with fusion; nucleon transfer in the reaction /sup 40/Ar + /sup 235/U; nuclear reactions and nuclear contact in U+U collisions below the barrier; deflection function and fragmentation in the system /sup 197/Au -> /sup 197/Au; search for exotic heavy nuclei using Rutherford backscattering). E. Ecology of radionuclides (preparation of plutonium samples for laser spectroscopy; laser resonance-ionization mass spectrometry on uranium and plutonium; capture of externally produced ions in a high frequency quadrupole trap; Chernobyl fallout in the Mainz area).

6209 **(JINR—R-6-86-229) Evaluation of adsorption enthalpies of gaseous metals on metallic surfaces and of deposition temperatures in thermochromatography.** Kim U Jin; Eichler, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700530/JAW.

For wide application of thermochromatographic method with metallic columns in separation and purification of metals in radiochemical practice the following calculations based on statistical thermodynamics methods are conducted. The enthalpy of adsorption of a gaseous metal on the surfaces of different metals have been calculated as the sum of the enthalpy of desublimation and net adsorption enthalpy. The last term is a function of the solution enthalpy of the adsorbate in the solid adsorbent metal and of the displacement energy. For certain standard experimental conditions the deposition temperature of gaseous metals in metallic thermochromatographic columns were calculated from the equation of linear ideal thermochromatography in columns with a stationary consrant temperature gradient. The adsorption enthalpies and the deposition temperatures were calculated for 48 metallic adsorbates on 10 metallic adsorbents - so that most cases of practical interest are covered. These data allow one to estimate the possibilities of separating concrete mixures of elements and to predict optimal conditions. 15 refs.; 3 figs.; 3 tabs.

6210 (UCD—472-131, pp 124-129) **Coordination chemistry of the Pb-212/Bi-212 nuclear transformation; alpha emitting radiopharmaceuticals.** Park, N.J.; Chelton, K.C.; Mishra, A.C.; Keen, C.L.; Zeidenberg-Cher, S.; Musker, K.W.; Bharadwaj, P.; Arbuckel, B.; Schneider, P.D.; Hill, A.D.; Lagunas-Solar, M.C.A. (Univ. of California, Davis). Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

This progress report briefly highlights the areas of research activity for FY85. Radiochemical procedures to produce Bi-205/206 tracer for chemical studies of the Pb-212 to Bi-212 nuclear transformation are reviewed. The developmental work on a Pb-212/Bi-212 generator system suitable for both chemical studies of recoil synthesis of Pb-212 Bi-212 compounds is discussed. Synthesis of candidate ligands that complex both lead and bismuth is discussed. Bismuth subcellular distribution and initial in vivo protein binding results are discussed.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 5396

6211 **(EFN-UTR—1986-1) Expose of projects in the field of combustion technology. Proceedings Chalmers 12-14 Nov 1985.** (Energiforskningsnaemnden, Stockholm (Sweden)). Jan 1986. 348p. (In Swedish). (CONF-8511309—). NTIS (US Sales Only), PC A15. Order Number DE88750395/JAW.

From Foerbrasnningsteknisk projektexpose; Goeteborg, Sweden (12 Nov 1985).

Research, education aquisition of scientific and technical competence and technology development within the field of combustion technology are of fundamental importance to Swedish

energy policy, to oil substitution as well as to the phasing out of nuclear power production. With the twofold objective to contribute to the exchange of information about ongoing research and achieved results between researchers in different projects, and to facilitate the transfer of results to different end users, an expose on research projects in the field of combustion technology was arranged. A large number of views and opinions on important matters for the future of combustion technology were expressed by qualified representatives from research institutions, companies, organizations and governmental agencies that participated. Different ways of improving knowledge transfer as well as feed-back from practical applications of fundamental research were discussed. The requirements of industry regarding education, experimental equipment and research organization were stressed. Examples were given of needs for new knowledge within important problem areas related to the environment. This volume contains the proceedings from the expos, with the lectures in the form they were submitted and with short summaries of three panel discussions that supplemented the lectures. A register over lectures as well as information on funding organizations has been added for convenience.

6212 **(INPE—4094-NTE/266) Nature of thermal ignition.** Gill, W.; Netto, D.B.; Andradedecarvalho, J. Jr. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jan 1987. 15p. (CONF-8610353—). NTIS, PC A02/MF A01.

From Explosives seminar; Sao Jose dos Campos, Brazil (1 Oct 1986).

The mathematical treatment of the thermal ignition problem as introduced in a recent paper is reviewed and interpreted. It is established that the solution to the steady state ignition problem sets the limits for the time dependent analysis which will allow the more practical and complex ignition problems to be studied.

6213 **(INPE—4179-NTE/269) Catalytic decomposition of hydrazine for micropropulsion.** Gill, W.; Eliziodepaula, F.C. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). May 1987. 21p. NTIS, PC A02/MF A01.

A study of hydrazine decomposition in a combustion chamber operating at different stagnation temperatures shows that the temperature can be controlled by the stagnation pressure. The performance of this system as a thruster is little affected by operation at low pressure, indicating the viability of such thrusters.

6214 **(N—87-27748) Comprehensive model to determine the effects of temperature and species fluctuations on reaction rates in turbulent reacting flows. Final report.** Chinitz, W. (Cooper Union, New York (USA)). Feb 1986. 118p. (NASA-CR—181227; NAS—1.26:181227). NTIS, PC A06/MF A01.

A computationally-viable model describing the interaction between fluid-mechanical turbulence and finite-rate combustion reactions, principally in high-speed flows was developed. Chemical kinetic mechanisms, complete and global, were developed describing the finite rate reaction of fuels of interest to NASA. These fuels included principally hydrogen and silane, although a limited amount of work involved hydrocarbon fuels as well.

6215 **(N—87-27973) Turbulence characteristics of an axisymmetric reacting flow. Final report.** Gould, R.D.; Stevenson, W.H.; Thompson, H.D. (Purdue Univ., Lafayette, IN (USA)). Sep 1987. 219p. (NASA-CR—180697; NAS—1.26:180697). NTIS, PC A10/MF A01.

Simultaneous two-component laser velocimeter measurements were made in the turbulent flow field following an axisymmetric sudden expansion with and without combustion. The fuel (propane) and air were fully premixed to give a constant fuel-air ratio of 0.032 at the inlet for the combusting flow measurements. Reynolds number based on step height was 55,700. The primary objective was to obtain detailed measurements which would be of use to modelers. Quantities measured included mean axial and radial velocities, Reynolds stresses, and turbulent triple products. In addition, simultaneous time resolved temperature measurements were made in the reacting flow using high speed thermocouples. This permitted the computation of velocity-temperature correlations. Experimental results were compared to predictions from a widely used numerical code based on the kappa-epsilon turbulence model and the combustion model of Magnussen and Hjertager. Relatively good agreement was found for the cold flow case as in previous studies, but predicted values of temperature in the reacting flow case deviated substantially from the measurements. Sizable errors in the predictions for the velocity field also were found. Possible sources for the observed differences and suggestions for future model development are suggested.

6216 **(UCRL—97547) The role of low temperature chemistry in the autoignition of n-butane.** Green, R.M.; Cernansky, N.P.; Pitz, W.J.; Westbrook, C.K. (Sandia National Labs., Livermore, CA (USA); Drexel Univ., Philadelphia, PA (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 19p. (CONF-871142—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002385/JAW.

From International fuels and lubricants meeting and exposition; Toronto, Canada (2 Nov 1987).

We have studied the chemical aspects of the compression ignition of n-butane experimentally in a spark ignition engine and theoretically using computer simulations with a detailed chemical kinetic mechanism. The results of these studies demonstrate the effect of initial charge composition on autoignition. Experimentally, when the initial charge consisted of 80% fresh charge and 20% recycled products of combustion, we observed that autoignition was inhibited. On the other hand, charging with 80% fresh charge and 20% partial oxidation products from the previous motored cycle resulted in enhanced low-temperature chemistry (with the associated heat release and temperature increase) and autoignition. We assessed how well the detailed kinetic model could predict the autoignition and modified the model to better simulate the experimental observations. We also assessed how chemical preconditioning of the fuel-air charge affected the autoignition process. 44 refs., 7 figs., 5 tabs.

6217 **Combustion chemistry.** Miller, J.A.; Fisk, G.A. (Sandia National Laboratories, Livermore, CA (USA)). *Chemical and Engineering News;* **65**: No. 35, 22-31, 34-46(31 Aug 1987).

This special report on combustion chemistry describes the numerous elementary chemical events leading from reactants to final products, liberating heat and producing unwanted pollutants. Progress in combustion chemistry is now achieved through the combined efforts of theory and experiment at both the microscopic, or elementary, and macroscopic or global, levels. The article describes why combustion data are required, and some theoretical models on thermochemical kinetics are discussed. Nitric oxide is an important pollutant formed by combustion and, together with sulfur oxides the chemical details of their formation are given. The chemistry of engine knock and turbulent non-premixed combustion are given. A number of related articles are included in the main text including, differential equations to solve the one-dimensional premixed flame problem, the mixing of products and combustion reactants with CSIR.

42 ENGINEERING

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 5433, 5472, 5796, 5839, 5953, 6926, 7056, 7067

6218 **(AD-A—184249/1/XAB) Adaptive subdivision method with crack prevention for rendering Beta-spline objects. Technical report, 7 August 1984-6 August 1987.** Barsky, B.A.; DeRose, T.D.; Dippe, M.D. (California Univ., Berkeley (USA). Berkeley Computer Graphics Lab.). 6 Aug 1987. 47p. NTIS, PC A03/MF A01.

Adaptive subdivision is a method of creating polygonal approximations to spline surfaces. An adaptive subdivision algorithm takes an input a spline surface and a tolerance epsilon, and outputs a piecewise planar approximation to the surface that is guaranteed to differ from the actual surface by a distance no greater than epsi-

lon. These algorithms proceed by recursively splitting the surface into smaller subsurfaces, ultimately approximating subsurfaces with planar polyhedra. These algorithms are therefore characterized by the mathematics behind the splitting of a surface, the test that is used to determine when to stop the recursion, and the method by which a subsurface is approximated by polyhedra. Algorithms of this type are currently known for spline techniques such as Bezier and B-splines. This paper describes the Beta-spline curve and surface technique and derive the equations governing the splitting of Beta-spline curves and surfaces. It presents a very general adaptive subdivision algorithm that can be used with a variety of surface techniques. It incorporates splitting criteria based on flatness and prevents cracks from occuring between approximating polyhedra. The tolerance controlling the splitting process may itself be adaptive, so that as an object moves farther away, the tolerance is automatically increased.

6219 **(AD-A—184261/6/XAB) Computer-aided structural engineering (CASE) project. User's guide: a three-dimensional stability analysis/design program (3DSAD). Report 1. General geometry module. Revision 1. Instruction report, June 1985-November 1986.** Tracy, F.T. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Information Technology Lab.). Jun 1987. 61p. (WES/IR/ITL—87-3-1). NTIS, PC A04/MF A01.

Revision 1 to AD-A087 074.

This module of the three-dimensional (3-D) stability analysis/design program (3DSAD) enables the engineer to describe the geometry of the 3-D structure, to interactively plot the desired structure, and then to obtain volume, weight, and centroid information for the structure. The general ways in which geometry is described are (a) two-dimensional cross sections extended in the third dimension, (b) eight-node brick elements, and (c) clusters of planar polygonal and bicubic patches. Curved segments can be circular, elliptical, or quadratic when using blocks and cubic when using patches. Objects can be copied, translated, rotated, or reflected about an axis as well. An arbitrary clipping plane can also be passed through the geometry.

6220 **(ANL/EES-TM—291) Proceedings of the workshop on requirements of mobile teleoperators for radiological emergency response and recovery.** Foltman, A.J. (ed.). (Argonne National Lab., IL (USA)). Feb 1986. Contract W-31109-ENG-38. 189p. (CONF-8506148—). NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE87013859/JAW.

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

Individual papers have been processed separately for the data bases. (TEM)

6221 (ANL/EES-TM—291, pp 61-64) **Ordnance disposal experience with mobile teleoperators.** Butler, J.; Nelson, D.J. (Naval Explosive Ordnance Disposal Technology Center, Indian Head, MD). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

This report describes the development and application of robot machines in the disposal of explosive ordnance. Application of advances in robot technology are contrasted with the need to keep remote ordnance disposal equipment inexpensive enough to be expendable. Features potentially useful to this work are discussed. (TEM)

6222 (ANL/EES-TM—291, pp 65-103) **Currently available mobile teleoperators and their applicability to radiological emergencies.** Gelhaus, F.; Meieran, H. (Electric Power Research Institute, Palo Alto, CA; HB Meieran Associates, Pittsburgh, PA). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

This report lists 69 mobile teleoperators currently available for use in nuclear emergencies. It is unlikely that a single unit will be able to overcome all obstacles encountered in an accident. These machines vary greatly in their capabilities and consequently in their applications. 2 refs., 12 figs., 2 tabs. (TEM)

6223 (ANL/EES-TM—291, pp 105-120) **Future directions in mobile teleoperation.** Hamel, W.R. (Oak Ridge National Lab., TN). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—). Contract AC05-84OR21400.

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

Current work appears to fall into two broad economic classes, one in the $100 K range and the other in the $1000 K range. Both are believed to be important for technology development and deployment. Recent developments confirm that we are at the technical doorstep of next-generation mobile systems which integrate dexterous manipulation, high mobility, and telerobotic operation. 16 refs., 8 figs.

6224 (ANL/EES-TM—291, pp 131-133) **Teleoperator transporters for RERR [Radiological Emergency Response and Recovery].** Whittaker, W.L. (Carnegie-Mellon Univ., Pittsburgh, PA). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—).

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

This report briefly describes seven existing types of teleoperated locomotion and compares these systems to animal movement. Of these seven modes, serpentine, ambulant, rolling, and prehensile locomotion modes were considered the best candidates for most accident situations. (TEM)

6225 (ANL/EES-TM—291, pp 141-158) **Mechanical accessories for mobile teleoperators.** Feldman, M.J.; Herndon, J.N. (Oak Ridge National Lab., TN). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—). Contract AC05-84OR21400.

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

The choice of optimum mechanical accessories for mobile teleoperators involves matching the criteria for emergency response with the available technology. This paper presents a general background to teleoperations, a list of the manipulator systems available, and an argument for force reflecting manipulation. The accomplishment of humanlike endeavors in hostile environments will be most successful when man model capabilities are used. The application of recent electronic technology to manipulator development has made new tools available for emergency response activities. 13 refs., 7 figs.

6226 (ANL/EES-TM—291, pp 159-173) **Power and signal transmission for mobile teleoperated systems.** Morris, A.C. Jr.; Hamel, W.R. (Oak Ridge National Lab., TN). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—). Contract AC05-84OR21400.

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

Appropriate means must be furnished for supplying power and for sending controlling commands to mobile teleoperated systems. This paper describes a number of umbilical, onboard, and wireless systems used in transmitting power that are available for mobile teleoperator services. The pros and cons of selecting appropriate methods from a list of possible communication systems (wired, fiber optic, and radio frequency) are also examined. Moreover, hybrid systems combining wireless power transmissions with command-information signals are also possible. 20 refs., 6 figs., 1 tab.

6227 (ANL/EES-TM—291, pp 175-178) **The human-machine interface in mobile teleoperators.** Draper, J.V. (Clarke Ambrose, Inc., Knoxville, TN). Feb 1986. NTIS, PC A09/MF A01. Order Number DE87013859/JAW. (CONF-8506148—). Contract AC05-84OR21400.

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

This report briefly summarizes man-machine interface systems and describes the limitations of such systems. Proposed improvements to existing hardware are discussed. (TEM)

6228 (AUC-IBT—8701) **Development of applicable methods for evaluating the safety of offshore structures. Pt. 4.** Sigurdsson, G. (Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik). Jan 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750383/JAW.

The reliability calculation of offshore structures is a difficult task due to the random nature of the loading, and also due to insufficient information of structural failure under these conditions. A stochastic assessment of the reliability analysis of offshore structures is therefore inevitable. Dynamic loads, such as wave loads, produce stress fluctuations in the structural members and joints and are the primary cause of fatigue damages. A fatigue analysis for offshore structures can be described in general terms as a calculation procedure, starting from the waves and ending with a fatigue damage occurring in the material or in the joints. The links between the waves and the damage are formed by mathematical models for the wave forces, the structural behaviour and the material behaviour. In view of the stochastic and dynamic character of the waves it is an obvious choice to apply spectral fatigue analysis methods to the fatigue problem. In this paper, a stochastic reliability assessment for jacket type offshore structures subjected to wave loads in deep water environments is outlined. In the reliability assessment, structural and loading uncertainties are taken into account by means of some stochastic variables. To estimate statistical measures of structural stress variations the modal spectral analysis method is applied. The analysis is divided into four steps: I) Description of the sea state a) short-term model b) long-term model. II) Description of the wave loading. III) Structural analysis. IV) Fatigue analysis. (LN).

6229 (BDX—613-3842) **Intelligent controllers.** Gross, V.E. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Oct 1987. Contract AC04-76DP00613. 12p. (CONF-8709167—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001862/JAW.

From CAM-I ANC interest group meeting; Cincinnati, OH, USA (29 Sep 1987).

The Intelligent Controller as a critical element in implementing factory automation and its general requirements are discussed. A brief review of the history of N/C controls, minicomputers, the APT programming language, and the potential role the ANC processor may play in Intelligent Controllers are also discussed. 4 figs.

6230 (CAPE—2998) **[Shipping containers] (Engineering Materials).** (Martin Marietta Energy Systems, Inc., Piketon, OH (USA)). 1987. Contract AC05-76OR00001. H. Order Number DE88000799/JAW.

Engineering drawings for shipping containers are presented. (BCS)

6231 (CONF-860778—Vol.1) **Proceedings, SDIO [Strategic Defense Initiative Organization]/DARPA [Defense Advanced Research Projects Agency] workshop on laser propulsion: Volume 1, Executive summary.** Kare, J.T. (ed.). (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87003254/JAW.

From SDIO/DARPA workshop on laser propulsion; Livermore, CA, USA (7 Jul 1986).

The primary charter of the Workshop was to consider the design of ground-to-orbit launch systems (as opposed to, e.g., orbit-changing propulsion). The first three days of the Workshop were devoted to talks on various aspects of laser propulsion and related areas such as FELs; an overview of these talks is presented in the following section. The remainder of the Workshop was devoted largely to discussions of specific issues in the design of laser-energized thrusters and laser launch systems. The development of any type of laser propulsion would significantly expand the range of feasible space missions. Several types of laser propulsion are thus mentioned herein, and work on all types of laser thrusters is recommended. True low-cost access to space, however, will require a laser launching system that is as simple and robust as possible. To this end, this summary emphasizes the extremely simple detonation-wave thruster concept, defined originally by Dennis Reilly and in its current form by Arthur Kantrowitz, on which the latter part of the Workshop concentrated.

6232 (CONF-871044—1) **Residual life evaluation of die-cushion cylinder in the 7500-ton press.** Yahr, G.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001731/JAW.

From ASME Pressure Vessels and Piping Division fall conference; Knoxville, TN, USA (21 Oct 1987).

A residual life evaluation of a die-cushion cylinder in a 7500-ton press that has been in service for 30 years was performed. Although the cylinder has been operated at internal pressures up to 4875 psi, there is concern about continued operation. A linear elastic fracture mechanics analysis was dose to establish the permissible future operating pressure based on conservative assumptions of the stresses and fatigue crack-growth rates in the cylinder. The analysis shows that the cylinder could be safely operated for 100,000 additional cycles provided the internal pressure does not exceed 1200 psi and provided a careful inspection is made to show that no significant surface flaws now exist in the vessel. In the absence of such inspection, the maximum future operating pressure must be restricted to 640 psi.

6233 (CONF-8710195—1) **A demonstration of autonomous navigation and machine vision using the HERMIES-IIB robot.** Burks, B.L.; Barnett, D.L.; Jones, J.P.; Killough, S.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002298/JAW.

From Southeastern Regional Media Leadership Council conference on microcomputers and artificial intelligence in communication technologies; Chattanooga, TN, USA (29 Oct 1987).

In this paper, advances to our mobile robot series (currently HERMIES-IIB) to include 8 NCUBE processors on-board, (computationally equivalent to 8 Vax 11/780's) operating in parallel, and augmentation of the sensor suite with cameras to facilitate on-board vision analysis and goal finding are described. The essential capabilities of the expert system described in earlier papers have been ported to the on-board HERMIES-IIB computers thereby eliminating off-board computation. A successful experiment is described in which a robot is placed in an initial arbitrary location without prior specification of the room contents, successfully discovers and navigates around stationary and moving obstacles, picks up and moves small obstacles, searches for a control panel, and reads the meters found on the panel. 19 refs., 5 figs.

6234 (DOE/OS/21400—T3) **Kinematic and elastic characteristics of couplings for precision fixturing.** Slocum, A.H. (National Bureau of Standards, Washington, DC (USA)). 13 Apr 1986. Contract AC05-84OS21400. 38p. (MS-DX—04-13-87). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001960/JAW.

This paper addresses some of the issues involved in choosing a coupling system to allow for quick change fixturing on high precision lathes. Hirth couplings are shown to be too complex for closed form analytical evaluation of their performance. Based on manufacturers specifications, if used to hold a 254 mm (10 in.) hemispherical vacuum chuck, part wall thickness errors on the order of 3.1 μm (120 μin.) would result. In addition, the teeth are often too course for the principle of elastic averaging to outweigh the requirement for an extensive wear-in period. Thus their use would require all fixtures to be worn in simultaneously, and all chucks must be re-worn-in if a new chuck or machine is added to the group. A closed form analysis of a three groove Kinematic coupling is then developed and used to design a Kinematic coupling with 28.6 mm (1 1/6 in.) diameter balls and 6675 N (1500 lbf) preload. When sub-

ject to cutting loads on the order of 67 N (15 lbf), a 356 mm (14 in.) diameter coupling produces the following wall thickness errors in a 254 mm (10 in.) diameter hemispherical part: (1) a 0.13 μm (5 μin.) error from cutting force, and (2) a 0.38 μm (15 μin.) error from 4% preload error. If Silicon Nitride balls and grooves are used, fretting corrosion of the interface will not be a problem. The kinematic design is shown to be unaffected by film contamination and does not require an extensive wear-in period. 8 refs., 12 figs.

6235 **(EGG-M—09386) Fuel removal, transport, and storage.** Reno, H.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 10p. (CONF-860724—14). NTIS, PC A02. Order Number DE88001498/JAW.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The March 1979 accident at Unit 2 of the Three Mile Island Nuclear Power Station (TMI-2) which damaged the core of the reactor resulted in numerous scientific and technical challenges. Some of those challenges involve removing the core debris from the reactor, packaging it into canisters, loading canisters into a rail cask, and transporting the debris to the Idaho National Engineering Laboratory (INEL) for storage, examination, and preparation for final disposal. This paper highlights how some challenges were resolved, including lessons learned and benefits derived therefrom. Key to some success at TMI was designing, testing, fabricating, and licensing two rail casks, which each provide double containment of the damaged fuel. 10 refs., 12 figs.

6236 **(EGG-SD—7847) Electronic imaging technique for welding and other high-luminosity processes.** Bolstad, J.O. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002199/JAW.

A new electronic imaging technique has been developed for use with electric arc welding and other high-luminosity processes. Intense light flashes are projected onto the welding site with a xenon flashlamp or pulsed laser. A conventional night-vision image-intensifier tube, used to view the welding site, is activated electronically only during the very brief duration of the light pulses. A small solid-state video camera captures the output image of the intensifier, and the light source is flashed at least once per video frame. The resulting video imagery is almost free of the welding arc light, and image quality is far superior to that obtained with ordinary video equipment. The technique has both experimental and industrial applications where there is need to see through intense arcs, plasmas, or flames, or to overcome the extreme spatial variation in brightness that is often characteristic of such processes. It can also be used to improve visibility of solid materials at high temperature, where surface detail is often masked by the self-luminosity of the material or by thermal equilibrium of the material with the walls of a furnace or kiln. 8 refs., 6 figs.

6237 **(ENEA-RT-PAS—87-2) Analysis of the criticality safety of a nuclear fuel deposit.** Landeyro, P.A.; Mincarini, M. (ENEA, Casaccia, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 31p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700761/JAW.

In the present work a safety analysis from criticality accidents of nuclear fuel deposits is performed. The analysis is performed utilizing two methods derived from different physical principes: 1) superficial density method, obtained from experimental research; 2) solid angle method, derived from transport theory.

6238 **(INIS-mf—10740) Investigation of the buckling sensitivity of hemispherical containers with arbitrary liquid content.** Menzel, A. (Hannover Univ. (Germany, F.R.). Inst. fuer Statik; Hannover Univ. (Germany, F.R.). Fakultaet fuer Bauwesen). Apr 1986. 77p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751014/JAW.

Mitteilungen des Instituts fuer Statik der Universtaet Hannover.; no. 31.

The stability behaviour of hemispherical containers filled with liquid is investigated with particular attention to the influence of geometrical imperfections. Of particular importance is the filling of the container. On the basis of a two parameter description of loading, which describes both the filling liquid and the filling condition, critical buckling parameters are calculated which represent an upper limit for the stability of the shell during the complete filling operation. The post-buckling behaviour of a perfect shell is related to a disturbance sensitivity. The influence of various imperfections and pre-buckling depths is demonstrated by means of load-deformation curves.

6239 **(LA-UR—87-3584) Assigning mass values to in-house standard UF_6 cylinders.** Goldman, A.; McGuire, D.; Croarkin, C. (Los Alamos National Lab., NM (USA); Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; National Bureau of Standards, Washington, DC (USA). Statistical Engineering Div.). 1987. Contract W-7405-ENG-36. 5p. (CONF-871110—2). NTIS, PC A02. Order Number DE88001796/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

A statistical experimental design called the Fast 4-1 Series is used to assign mass values to in-house standard UF_6 cylinders. This design is intended to minimize the number of weighings of large cylinders yet provide acceptable estimates of mass values and their precision. 5 refs.

6240 **(NIIEFA-P-B-OM—0682) To the problem of strain measuring at low temperatures in magnetic fields.** Zhelamskij, M.V.; Lantsetov, A.A.; Malkov, A.A.; Semenov, O.V.; Sukhanova, M.V.; Trokhachev, G.V. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700571/JAW.

Grounds for construction of a test bed to study strain gages characteristics at ultralow temperatures in static magnetic fields are considered. The test bed construction and flowsheet of the developed information-measurement system are described. 6 refs.; 3 figs.

6241 **(PNL-SA—14630) Metal segmenting using abrasive and reciprocating saws.** Allen, R.P.; Fetrow, L.K.; Haun, F.E. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 10p. (CONF-871018—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001905/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper evaluates a light-weight, high-power abrasive saw for segmenting radioactively contaminated metal components. A unique application of a reciprocating mechanical saw for the remote disassembly of equipment in a hot cell also is described. The results of this work suggest that use of these techniques for selected remote sectioning applications could minimize operational and access problems and be very cost effective in comparison with other inherently faster sectioning methods. 2 refs., 7 figs.

6242 **(RFP—4122) Application technology progress report: Evaluation of PM-10 commercial inlets and development of an inlet for new Rocky Flats Plant surveillance air sampler, January 1986-December 1986.** Langer, G.; Deitesfeld, C.A. (ed.0. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 10 Sep 1987. Contract AC04-76DP03533. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002483/JAW.

Work during 1986 was concerned with developing a new PM-10 inlet for use at Rocky Flats Plant (RFP), Golden, Colorado. The commercial units that we evaluated did not allow for recovery of the >10-μm dust fraction as may be required by EPA and DOE for nuclear installations. One of them, the Wedding PM-10 Inlet, did not meet the PM-10 cut-point requirement, because of the build-up of vegetative fibers in the cyclone type separator. Therefore, we developed a new PM-10 inlet (patent applied for) to meet our needs, and especially one that is adaptable to our existing 60 surveillance air samplers at minimum cost. The inlet utilizes a modi-

fied slotted impactor design. This device is directly adaptable to existing EPA high-volume samplers. 9 refs., 5 figs., 1 tab.

6243 **(SAND—87-2570C) Hypersonic flight testing.** Williamson, W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 48p. (CONF-871227—1-Vugraphs; CONF-8704229—1-Vugraphs). NTIS, PC A03. Order Number DE88001655/JAW.

From Joint US/Europe short course on hypersonics; Paris, France (7 Dec 1987).

This presentation is developed for people attending the University of Texas week-long short course in hypersonics. The presentation will be late in the program after the audience has been exposed to computational tehniques and ground test methods. It will attempt to show why we flight test, flight test options, what we learn from flight tests and how we use this information to improve our knowledge of hypersonics. It presupposes that our primary interest is in developing vehicles which will fly in the hypersonic flight region and not in simply developing technology for technology's sake. The material is presented in annotated vugraph form so that the author's comments on each vugraph are on the back of the preceding page. It is hoped that the comments will help reinforce the message on the vugraph.

6244 **(UCID—21225) Fabrication techniques used in the construction of a high resolution x-ray framing camera.** Cook, W.M.; Stearns, D.G. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002653/JAW.

A high resolution x-ray framing camera (HRXFC) has been developed for use as a diagnostic tool for laser fusion experiments that is capable of recording a two-dimensional radiographic "snapshot" of an imploding fusion target with a shutter speed of <100 ps. Recent tests of a complete prototype instrument have demonstrated frame durations as short as 40 ps FWHM. The HRXFC is based on a gated 15-ohm strip transmission line. Into this stripline are imbedded various elements, both active and inactive, that must perform their respective functions while having a negligible impact on the electrical characteristics of the transmission line. A discussion of the theory of operation of the HRXFC is presented along with an introduction to the elements of the stripline and their functions. This is followed by a discussion of the special techiques used to fabricate the instrument. 10 figs.

6245 **Combination closed-cycle refrigerator/liquid-He^4 cryostat for e^- damage of bulk samples.** Johnson, E.C. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Review of Scientific Instruments;* **58**: No. 12, 2295-2297(Dec 1987). Contract AC02-76ER01198.

A closed-cycle refrigerator/cryostat system for use in ultrasonic studies of electron irradiation damaged bulk specimens is described. The closed-cycle refrigerator provides a convenient means for long-term (several days) sample irradiation at low temperatures. A neon filled "thermal diode" is employed to permit efficient cooling, via liquid helium, of the sample below the base temperature of the refrigerator.

6246 **Advances in cryogenic engineering. Volume 31; Proceedings of the Cryogenic Engineering Conference, MIT, Cambridge, MA, Aug. 12-16, 1985.** Fast, R.W. New York, NY; Plenum Press (1986). 1368p.

The present conference on the applications of state-of-the-art cryogenic engineering technologies considers topics associated with the development status of the Superconducting SuperCollider, superconducting magnetic energy storage methods, large magnets for fusion and other physics researches, cryogenic hardware improvements, and phenomena and applications of superconducting magnet-employing acoustic emission test equipment. Also discussed are design criteria for superconducting magnet stability, heat exchangers and heat transfer to liquid He and N, heat and mass transfer characteristics of He II, refrigeration techniques for magnetic resonance imaging and other small systems, refrigeration for liquefaction and for superconducting fusion as well as for accelerator and generator systems, magnetic refrigeration, cryocooling and refrigeration for space applications, the storage and transfer of cryogenic fluids, the properties of cryogenic liquids, and air liquefaction equipment.

4203 Lasers

REFER ALSO TO CITATION(S) 5582, 5583, 5585, 5663, 6639, 7015

6247 **(AD-A—184269/9/XAB) Free-electron laser sideband instability reconsidered. Interim report.** Riyopoulos, S.; Tang, C.M. (Naval Research Lab., Washington, DC (USA)). 12 Aug 1987. 53p. (NRL-MR—6028). NTIS, PC A04/MF A01.

The problem of sideband growth in a free-electron laser (FEL) is studied using canonical formalism. The exact unperturbed orbits, without sidebands, are obtained in action-angle variables for all particles. Integration of the linearized Vlasov equation with perturbing sidebands over the unperturbed orbits yields the sideband growth for both trapped and untrapped particles. The unperturbed distribution f sub o is in an equilibrium with the main signal field. It is found that upper and lower sidebands that are symmetric relative to the FEL frequency have opposite growth rates. There is no differentiation in the magnitude of the growth between upper and lower sidebands. The stability is determined by the sign of df sub o/d(omega sub b), i.e., the relative population of oscillation quanta (h-bar)(omega sub b), omega sub b = bounce frequency around resonance. The shear d (omega sub b)/dj, where J is the action variable, is stabilizing and distributions with gradients df sub o/dJ localized near the separatrix have the minimum growth rates. The structure and scaling of the unstable spectrum are different from previous results obtained for electrons localized at the bottom of the ponderomotive well.

6248 **(AD-A—184315/0/XAB) All-optical beam control by forced Rayleigh scattering. Annual report, 15 February-15 September 1985.** Peterson, L.M. (Environmental Research Inst. of Michigan, Ann Arbor (USA). Advanced Concepts Div.). Dec 1986. 63p. (ERIM—175900-11-T). NTIS, PC A04/MF A01.

An analysis is presented to support the experimental efforts directed toward the achievement of all-optical beam control based upon nonlinear optical effects of thermal origin. Although Stimulated Thermal Rayleigh Scattering (STRS) is the primary effect of interest, the analysis falls in the broader category of Forced Rayleigh Scattering (FRS) where the underlying principles are the same. The interference of two coherent beams of radiation is discussed quantitatively and serves as the driving mechanism for creating a thermally-induced phase grating in an absorbing liquid, which is also discussed quantitatively. The analysis shows that, for the experimental conditions, an efficient thermal-phase grating can be generated using laser pulses possessing a few microjoules of energy, and is being pursued experimentally using nanosecond laser pulses. A dye laser using a grazing-incidence grating (Litterman design) which was purchased for its narrower spectral linewidth and longer coherence length compared to the previous dye laser is also described.

6249 **(AD-A—184449/7/XAB) Investigation of single-crystal silicates for blue tunable lasers. Final report, 1 September 1985-1 September 1986.** Belt, R.F.; Catalano, J.A. (Litton Systems, Inc., Morris Plains, NJ (USA). Airtron Div.). 26 Sep 1986. 36p. NTIS, PC A03/MF A01.

The single-crystal growth of rare earth silicates was investigated for the purpose of tunable laser host. Silicates of the type R_2SiO_5, where R + La, Gd, Y were prepared from stoichiometric melts and doped with Ce^{+3} activator. Seed crystals were obtained from crystallized melt sections or by growth on an iridium wire. Cathodoluminescence experiments on both powders and single crystals showed wavelength shifts with different rare earth ions. The Gd, Y, and mixed crystals of Cd-Y silicates gave good bright emission with Ce^{+3}. The emission is broadband and covers the wavelength range of 370-525nm. The peak emission can be centered near 450-460 micrometers by other compositions. Large single crystals of $Gd_2SiO_5:Ce^{+3}$ were grown. One growth run of

$Mg_3SiO_4:Ti^{+3}$ yielded a small boule which showed cathodoluminescence under e-beam illumination.

6250 **(N—87-26992) Innovative methods for the measurement of I* quantum yields and kinetics by diode laser gain-versus-absorption. Final report, 1 July 1985-30 June 1987.** Leone, S.R. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). Jun 1987. 7p. (NASA-CR—180999; NAS—1.26:180999). NTIS, PC A02/MF A01.

The quantum yields of a variety of candidate molecules for solar lasant materials to produce I* were tested. The absorption spectrum was measured for each compound and the I* yield determined by the diode laser or by infrared emission, using C_3F_7I as a standard. The results of these measurements are summarized. A GaAsInP diode laser system was developed to probe I and I* atoms to obtain yields and kinetics. A technique of gain-versus-absorption spectroscopy was investigated to measure quantum yields with high accuracy. The errors in the yield data were reduced to +/- 2% or less. In addition, experiments were set up to measure the rates of F-sublevel changing collisions in both the I ground state and the I* excited state. Finally, experiments and modelling were carried out to explore the possibility of measuring the recombination rates of I* with C_3F_7 radicals.

6251 **(N—87-27165) Design and chemical synthesis of iodine-containing molecules for application to solar-pumped I* lasers. Semiannual progress report, 1 July-31 December 1986.** Shiner, C.S. (Colorado Univ., Boulder, (USA). Cooperative Inst. for Research in Environmental Sciences). Dec 1986. 13p. (NASA-CR—180297; NAS—1.26:180297). NTIS, PC A02/MF A01.

Research is directed toward the design and synthesis of new media for solar-pumped I* lasers. Since the most effective existing lasants are perfluoroalkyl iodides, a strategy was proposed for the development of improved materials of this type with absorption maxima at 300 nm. Absorption spectra were synthesized and measured for prototypical species containing iodine bound to boron, iron, and cobalt.

6252 **(N—87-27166) Absolute 1* quantum yields for the ICN A state by diode laser gain versus absorption spectroscopy. Semiannual status report.** Hess, W.P.; Leone, S.R. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). Jan 1987. 30p. (NASA-CR—180344; NAS—1.26:180344). NTIS, PC A03/MF A01.

Absolute I* quantum yields were measured as a function of wavelength for room temperature photodissociation of the ICN A state continuum. The temperature yields are obtained by the technique of time-resolved diode laser gain-versus-absorption spectroscopy. Quantum yields are evaluated at seven wavelengths from 248 to 284 nm. The yield at 266 nm is 66.0 +/- 2% and it falls off to 53.4 +/- 2% and 44.0 +/- 4% at 284 and 248 respectively. The latter values are significantly higher than those obtained by previous workers using infrared fluorescence. Estimates of I* quantum yields obtained from analysis of CN photofragment rotational distributions, as discussed by other workers, are in good agreement with the I* yields. The results are considered in conjunction with recent theoretical and experimental work on the CN rotational distributions and with previous I* yield results.

6253 **(N—87-27168) Mathematical modeling of a Ti:sapphire solid-state laser. Final report, period ending 15 May 1987.** Swetits, J.J. (Old Dominion Univ., Norfolk, VA (USA)). May 1987. 33p. (NASA-CR—181105; NAS—1.26:181105). NTIS, PC A03/MF A01.

The project initiated a study of a mathematical model of a tunable Ti:sapphire solid-state laser. A general mathematical model was developed for the purpose of identifying design parameters which will optimize the system, and serve as a useful predictor of the system's behavior.

6254 **(N—87-27186) Dynamic characteristics of far-field radiation of current modulated phase-locked diode laser arrays. Final technical report, 1 February 1986-31 July 1987.** Elliott, R.A.; Hartnett, K. (Oregon Graduate Center, Beaverton (USA)). Jul 1987. 17p. (NASA-CR—181002; NAS—1.26:181002). NTIS, PC A02/MF A01.

A versatile and powerful streak camera/frame grabber system for studying the evolution of the near and far field radiation patterns of diode lasers was assembled and tested. Software needed to analyze and display the data acquired with the steak camera/frame grabber system was written and the total package used to record and perform preliminary analyses on the behavior of two types of laser, a ten emitter gain guided array and a flared waveguide Y-coupled array. Examples of the information which can be gathered with this system are presented.

6255 **(N—87-27544) Electrical and optical study of semiconductor laser diodes and materials. Final report, period ending 31 August 1987.** Albin, S. (Old Dominion Univ., Norfolk, VA (USA)). Sep 1987. 28p. (NASA-CR—181294; NAS—1.26:181294). NTIS, PC A03/MF A01.

The characterization of a 2-D diode laser array from McDonald Douglas has been completed. The array consisted of 8 linear arrays of approximately 11 mm x 0.18 mm. Each array has between 7 and 8 diodes per mm. The threshold current is approximately 15 amps. The power output vs drive current (above threshold) of the array was measured. A peak power of 50 W was obtained at a drive current of 26 amps. Its far field pattern has a double lobe.

6256 **(N—87-27998) Titanium-doped sapphire laser research and design study. Final contractor report.** Moulton, P.F. (Schwartz Electro-Optics, Inc., Concord, MA (USA)). Sep 1987. 59p. (NASA-CR—4093; NAS—1.26:4093). NTIS, PC A04/MF A01.

Three main topics were considered in this study: the fundamental laser parameters of titanium-doped sapphire, characterization of commercially grown material, and design of a tunable, narrow-linewidth laser. Fundamental parameters investigated included the gain cross section, upper-state lifetime as a function of temperature and the surface-damage threshold. Commercial material was found to vary widely in the level of absorption of the laser wavelength with the highest absorption in Czochralski-grown crystals. Several Yi:sapphire lasers were constructed, including a multimode laser with greater than 50mJ of output energy and a single-transverse-mode ring laser, whose spectral and temporal characteristics were completely characterized. A design for a narrow-linewidth (single-frequency) Ti:sapphire laser was developed, based on the results of the experimental work. The design involves the use of a single-frequency, quasi-cw master oscillator, employed as an injection source for a pulsed ring laser.

6257 **(PB—87-228243/XAB) Multi-purpose laser-diode modules.** Shibanuma, N.; Ohshima, Y.; Kosuge, K.; Ogawa, T.; Shikada, M. (Nippon Electric Co. Ltd., Tokyo). 1987. 7p. (In Japanese). NTIS, PC E09/MF A01.

Included in NEC (Nippon Electric Company) Technical Jnl., Vol. 40, No. 5, 31-36(May 1987).

Butterfly- and DIP-packaged semiconductor laser-diode modules with single-mode fiber pigtail have been developed, as the light sources for optical-fiber telecommunication systems ranging from high bitrate and long-haul trunk lines to short-haul junction lines, featuring the following specific advantages such as, (1) laser-welding-assembly technique assures excellent reliability, (2) stable and efficient coupling is obtained in the wide range of ambient temperature, (3) butterfly- or DIP-packaged for the facility of installation in the terminal sets, (4) high bitrate modulation up to 1.2 Gbps is available, (5) DFB laser will be optionally available.

6258 **(PB—87-228334/XAB) Precise beam-alignment He-Ne laser tubes.** Hara, H.; Hoshi, K.; Ishihara, H. (Nippon Electric Co. Ltd., Tokyo). 1987. 4p. (In Japanese). NTIS, PC E09/MF A01.

Included in NEC (Nippon Electric Company) Technical Jnl., Vol. 40, No. 5, 157-159(May 1987).

Internal-mirror He-Ne laser tubes with 632.8 nm are very popular lasers, used for printers, scanners, measurement, agriculture/construction, medical and various R&D purposes, because of their high-quality visible beams, relatively low cost and easy maintenance. NEC has recently developed its new series of He-Ne laser tubes which have precisely aligned output beam with regard to the tube axis and many other superior features compared to conventional He-Ne laser tubes. For their highly precise beam alignment, users can eliminate their elaborate alignment procedure in the system assembly and/or tube replacement. These new models are especially suitable for POS/handheld scanners with their precise beam alignment and small size. This paper gives an outline of the characteristics and design of these new series He-Ne tubes.

6259 **(UCRL—15954) Low-power photolytically pumped lasers: Final technical report.** Messing, I.; Lorents, D.C.; Eckstrom, D.J. (SRI International, Menlo Park, CA (USA)). Aug 1987. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002448/JAW.

We have carried out an extensive series of measurements of the time-resolved Xe_2^* emission spectra following optical pumping by a short-pulse F_2 laser at 157.6 nm. Most measurements were performed using a gated Optical Multichannel Analyzer detector; we also made measurements using a scanning monochromator fitted with a photomultiplier and using a boxcar integrator for time resolution. The two sets of results agree well and show that both the singlet and triplet emission bands are broader than expected and have center wavelengths closer together than expected. Measurements were performed both at room temperature and at elevated (140°C) and reduced (-27°C) temperatures. The broad bandwidth of the individual spectral bands was unexpected and conflicted with a previous spectral measurement using optical pumping by the Xe* resonance line from a microwave discharge lamp. Therefore, we also performed a series of spectral measurements using this type of optical pumping. We achieved good agreement with some previous results in the literature, but not with the result in question. We conclude that the present results are reliable. The results presented in this report provide the first definitive measurement of the individual excimer emissions from each of the $Xe_2(0/sub\ u/^+)$ and $Xe_2(1/sub\ u/)$ states. From these measurements and the known ground state potential, we derived a 1/sub u/ potential that reproduces the emission band very well. However, the 1/sub u/ potential is in substantial disagreement with the recent 1/sub u/ potential derived by the Toronto group. 13 refs., 32 figs., 3 tabs.

6260 **(UCRL—15971) Chapter 2: Threshold for Raman conversion of FEL laser pulses in the atmosphere: Final report.** Ori, A.; Rokni, M. (Lawrence Livermore National Lab., CA (USA); Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1987. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002470/JAW.

Transmission of a high intensity laser beam through the atmosphere can be affected by a variety of stimulated and parametric nonlinear processes. As a result, gain at other wavelengths will be generated along the propagation path of the beam. But the conversion of the original laser energy into other wavelengths is not the only result. Unless special measures are taken, the wavefront of the Raman shifted radiation will be determined by the turbulence in the atmosphere and by the aspect ratio of the gain medium. These processes will lead to beam divergences which can be significantly greater than the diffraction limit. As a result of these nonlinear processes, it will not be possible to efficiently propagate the beam unless proper measures are taken. Developing a quantitative model is especially important for determining the propagation characteristics of FEL laser pulses through the atmosphere. The objective of this research report is to present such a time dependent model for stimulated Raman conversion of short laser pulse propagating in the atmosphere and to calculate the threshold laser pulse energy and intensity for stimulated rotational Raman scattering as a function of wavelength, pulse width and beam diameter. 12 refs., 10 figs.

6261 **Copper vapor laser acoustic thermometry system.** Galkowski, J.J. (to Dept. of Energy, Washington, DC). US Patent 4,697,270. 29 Sep 1987. Filed date 27 Aug 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A thermometry system is described for a laser comprising: alumina rod means for axially coupling an acoustic pulse a predetermined distance from a coupling point into the interior of the laser such that an echo pulse corresponding to the acoustic pulse is reflected from the interior of the laser to the coupling point without affecting operation of the laser, means for measuring a period of time between the coupling of the acoustic pulse and the return of the echo pulse to the coupling point, and means for processing the measured time difference to provide a temperature indication at the predetermined interior point within the laser.

6262 **Deuterated L-arginine phosphate monohydrate.** Eimerl, D. (to Dept. of Energy, Washington, DC). US Patent 4,697,100. 29 Sep 1987. Filed date 17 Jan 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An apparatus is described for frequency conversion of light. The apparatus comprises: a laser for generating a laser beam; and at least one crystal according to the formula: (X/sub 2/N)/sub 2/ CNX (CH/sub 2/)/sub 3/ CH (NX/sub 3/)/sup +/COO/sup -./ / sup X//sub 3/PO/sub 4/. X/sub 2/O where one or more of the X's represent deuterium replacing hydrogen and with any remaining X locations still being hydrogen. The at least one crystal is placed in the laser beam in an orientation for frequency conversion of the laser beam.

6263 **Combination scattering of a magnetized free electron with a longitudinal wiggler.** Chien, C.; Lin, A.T. (Dept. of Physics, Univ. of California, Los Angeles, CA). pp 4B-6 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

In this paper it has been shown that a relativistic electron beam with finite transverse dc momentum passing through a region of combined dc and wiggler fields is capable of generating radiation at frequency $\omega = 2\gamma/sup\ 2/(k/sub\ w/v/sub\ o/ + \omega/sub\ c/)$ where $\omega/sub\ c/$ is the relativistic electron cyclotron frequency. The resonance condition is $\omega = (k = k/sub\ w/)\ V/sub\ o/ + \omega/sub\ c/$ and the efficiency of this device is of the order 1%. On the other hand, the efficiency of a Doppler-shift dominated cyclotron maser/sup 2/ operated at $V/sub\ ph/ \simeq$ can reach 30%. Therefore, it is possible to have a magnetized free electron laser with a longitudinal wiggler to satisfy both the resonance condition and $V/sub\ ph/ \simeq c$. In doing so, the phase shift due to Doppler contribution and cyclotron term will compensate each other and the wave can remain in resonance with the electrons for a long time. The authors have carried out computer simulations with $\omega/sub\ c/ = k/sub\ w/V/sub\ o/$, $\beta/sub\ 1/ = 1/\gamma/sub\ o/$ and $\gamma/sub\ o/ = 2.5$ and observed radiation at $\omega = 10\omega/sub\ c/$ with 13% efficiency. The saturation is caused by the trapping of the electrons by the wiggler mirror field.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 5472, 6215, 6309

6264 **(EIR—627) Experimental investigation of water sprayed finned heat exchanger tube bundles. Heat and flow technical aspects.** Sommer, A. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1987. 175p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700588/JAW.

Experimental investigations have been made to study the performance of two finned tube-bundle heat exchangers (FORGO type) when wetted by water sprays. The heat exchangers are designed to cool water in a dry cooling tower. The test-elements had a frontal area of 1 m/sup 2/. The water sprays were created by 20

nozzles, 200 mm in front of the heat exchangers. Air velocities at the inlet of the coolers were in the range 0,8 m/s to 12 m/s and initial temperature differences ITD reached 45 degrees C. The test facility was designed to determine the combined latent and sensible heat fluxes in the wetted heat exchanger, the airside pressure drop and the air humidity and temperature at the exchanger inlet and outlet, and to measure the weight of the water wetting the cooler's surface. The sprayed test elements were investigated in different positions, but most of the experiments were carried out in the position with the fins horizontal.

6265 **(EIR—629) Boil-off experiments with the EIR-NEPTUN facility: analysis and code assessment overview report.** Aksan, S.N.; Stierli, F.; Analytis, G.Th. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700590/JAW.

The NEPTUN data discussed in this report are from core uncovery (boil-off) experiments designed to investigate the mixture level decrease and the heat up of the fuel rod simulators above the mixture level for conditions simulating core boil-off for a nuclear reactor under small break loss-of-coolant accident conditions. The first series of experiments performed in the NEPTUN test facility consisted of ten boil-off (uncovery) and one adiabatic heat-up tests. In these tests three parameters were varied: rod power, system pressure and initial coolant subcooling. The repeatability of the experiments was also demonstrated. The NEPTUN experiments showed that the external surface thermocouples do not cause a significant cooling influence in the rods to which they are attached under boil-off conditions. The reflooding tests performed later on indicated that the external surface thermocouples have some effect during reflooding for NEPTUN electrically heated rod bundle. Peak cladding temperatures are reduced by about 30-40 degrees C and quench times occur 20-70 seconds earlier than rods with embedded thermocouples. Additionally, the external-surface thermocouples give readings up to 20 K lower than those obtained with internal surface thermocouples (in the absence of external thermocouples) in the peak cladding temperature zone. Some of the boil-off data obtained from the NEPTUN test facility are used for the assessment of the thermal-hydraulic transient computer codes. These calculations were performed extensively using the frozen version of TRAC-BD1/MOD1 (version 22). A limited number of assessment calculations were also done with RELAP5/MOD2 (version 36.02). In this report the main results and conclusions of these calculations are presented with the identification of problem areas in relation to the models relevant to boil-off phenomena. (Abstract Truncated)

6266 **(EIR—631) NEPTUN-III reflooding and boil-off experiments with an LWHCR fuel rod bundle simulator: experimental results and initial code assessment efforts.** Dreier, J.; Analytis, G.; Chawla, R. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700591/JAW.

The NEPTUN test facility at Wuerenlingen has been modified to enable LWHCR-representative reflooding and boil-off experiments to be carried out. Results from a first series of forced feed reflooding tests, simulating cold-leg injection, are presented for a range of values of the parameters flooding rate, rod power and initial temperature. Rewetting of the LWHCR fuel bundle simulator was found to be possible in each case. Analysis of the NEPTUN-III reflooding experiments with RELAP5/MOD2 yield discrepant results and it has been shown, in the context of calculations of the boil-off experiments, that some LWHCR-specific models and correlations need to be developed.

6267 **(N—87-27936) Modeling of transient heat pipe operation. Semiannual status report, 19 August 1986-18 February 1987.** Colwell, G.T. (Georgia Inst. of Tech., Atlanta (USA)). Jul 1987. 36p. (NASA-CR—180280; NAS—1.26:180280). NTIS, PC A03/MF A01.

The use of heat pipes is being considered as a means of reducing the peak temperature and large thermal gradients at the leading edges of reentry vehicles and hypersonic aircraft and in nuclear reactors. In the basic cooling concept, the heat pipe covers the leading edge, a portion of the lower wing surface, and a portion of the upper wing surface. Aerodynamic heat is mainly absorbed at the leading edge and transported through the heat pipe to the upper and lower wing surface, where it is rejected by thermal radiation and convection. Basic governing equations are written to determine the startup, transient, and steady state performance of a haet pipe which has initially frozen alkali-metal as the working fluid.

6268 **(N—87-28346) Research on computational fluid dynamics and turbulence. Semiannual report.** (Brown Univ., Providence, RI (USA)). 1986. 80p. (NASA-CR—180304; NAS—1.26:180304). NTIS, PC A05/MF A01.

Preconditioning matrices for Chebyshev derivative operators in several space dimensions; the Jacobi matrix technique in computational fluid dynamics; and Chebyshev techniques for periodic problems are discussed.

6269 **(PB—87-231585/XAB) Computation of three-dimensional viscous transonic flows using the LU-ADI factored scheme. Technical report.** Fujii, K.; Obayashi, S. (National Aerospace Lab., Chofu, Tokyo (Japan)). 1985. 22p. (IN Japanese). (NAL-TR—889T). NTIS, PC E03/MF A01.

The LU-ADI factored scheme has been successfully applied to solve the three-dimensional compressible thin-layer Navier-Stokes equations. The computations are carried out for the slightly supersonic flow over a hemisphere cylinder at high incidence and for the transonic flow over a swept wing. To simulate these complicated flow fields, fine grid distributions of up to about 200,000 points were used on a new Japanese supercomputer of 1 GFLOPS. The total cpu time for each case was less than two hours.

6270 **(UCID—21175) Bubble expansion an collapse studies: FY87 annual report.** Reitter, T.A. (ed.); Rosinsky, R.W.; Steinberg, D.J.; Tipton, R.E.; Zimmerman, H.I. (Lawrence Livermore National Lab., CA (USA)). 28 Aug 1987. Contract W-7405-ENG-48. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002377/JAW.

The literature has been surveyed and one-dimensional (1-D) and two-dimensional (2-D) calculations have been performed of bubble expansion and collapse in water. Despite an extensive literature, there is one case of direct comparison of experimental data and calculations. The 2-D calculations of bubble expansion and collapse near a wall, using four different hydrodynamics codes, have revealed the difficulties of calculating a problem characterized by many weak shocks and a long period of relatively small changes, preceded and followed by short periods of rapid change and large distortions. It has been concluded that experimental data collected for the purpose of code improvements are necessary, and that new calculational tools are also necessary for improved understanding of the behavior of collapsing bubbles.

6271 **(UCRL—15926-87) Rayleigh-Taylor instability in compressible fluids: Final report, 1 October 1986-30 September 1987.** Sturtevant, B. (California Inst. of Tech., Pasadena (USA). Graduate Aeronautical Labs.). 4 Sep 1987. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002473/JAW.

The purpose of this research program is to investigate fluid dynamic instabilities and mixing initiated by the interaction of shock waves with interfaces between light and heavy gases. In particular, the nonlinear stage of shock-initiated Rayleigh-Taylor instability, the secondary instabilities (e.g., the Kelvin-Helmholtz instability) arising therefrom and the concomitant mixing of the two gases are of interest. This report describes activities during the performance period 1 October 1986 to 30 September 1987.

6272 **(N—87-27974) Heat transfer during the boiling of liquids in heat pipe wicks.** Gontarev, Y.K.; Navruzov, Y.V.; Prisnyakov, V.F.; Serebryanskiy, N. Translated from *Promyshlennaya Teplotekhnika ;* 8: No. 4, 11-14(Aug 1987). 10p. (NASA-TT—20108; NAS—1.77:20108). NTIS, PC A02/MF A01.

Data in the literature on heat transfer in the case of nucleate boiling of various liquids in the wicks of heat pipes are reviewed. It is shown that none of the known analytical relationships can be used to generalize, with sufficient accuracy, the experimental data found in the literature. It is further shown that the exponent of the specific heat flux in the heat transfer law changes as a function of the liquid and wick properties. A relationship is obtained which generalizes experimental data for heat transfer agents of moderate temperatures (water, acetone, ethanol, and R-11 and R-113 coolants) and ammonia.

6273 **Survey of turbulent forced-convection heat transfer and pressure drop characteristics of low-finned tube banks in cross flow.** Rabas, T.J.; Taborek, J. (Argonne National Lab., Argonne, IL 60439). *Heat Transfer Engineering;* 8: No. 2, 49-62(1987).

This paper presents a survey based on the scattered literature dealing with the heat transfer and pressure drop performance of low-finned tube banks. Only the turbulent forced-convection mode of heat transfer is considered for pure cross flow. Heat transfer and pressure drop correlations are recommended for a wide Reynolds number range of 1000 to 200,000. The necessary corrections for nonequilateral tube arrangements, temperature-dependent fluid properties, row number effects, and bundle side leakage are also identified.

4205 Materials Testing

REFER ALSO TO CITATION(S) 5699, 6234, 6819

6274 **(EGG-M—09787) A new view of the ultrasonic behavior of cast austenitic steels.** Beller, L.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 8p. (CONF-8611147—5). NTIS, PC A02. Order Number DE88001538/JAW.

From 8. international conference on NDE in the nuclear industry; Orlando, FL, USA (17 Nov 1986).

A three-dimensionally anisotropic model of the cast austenitics is proposed and tested experimentally. The model predicts unique propagation modes and directions, which are observed experimentally in centrifugally cast stainless steel (CCSS) specimens, but which are not predicted by the single- preferred-axis model. It accounts for a large share of the difficulties noted in ultrasonic inspection of these materials by conventional techniques. The model also suggests a technique for significant improvement in signal/noise ratio (SNR) and i. apparent attenuation; this technique is demonstrated experimentally to give striking improvements in SNR. In addition, a number of previously anomalous behaviors are explained by this model. 10 refs., 6 figs.

6275 **(IAEA-TECDOC—407) Training guidelines in non-destructive testing techniques.** (International Atomic Energy Agency, Vienna (Austria)). Feb 1987. 211p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700613/JAW.

With the conclusion in 1979 of a successful Agency executed UNDP project in Argentina, whose aim was the establishment of a national non-destructive testing centre, the Agency was asked by other countries in the Latin American and Caribbean Region to evaluate the possibility of transferring this success to the whole region. In 1982, with the financial cooperation of UNFSSTD and UNIDO, a regional project was started with the principal objective of assisting the countries in the region to reinforce autonomous NDT capability through regional cooperation. One essential component of this project has been the harmonization of training through the development and use of course syllabi by the 17 countries now participating in the project. To this end, a Regional Working Group was formed and one of its tasks is the development of these syllabi for the more common NDT methods. This publication is a collection of the training programmes elaborated to date which have so far been followed by some 10,000 persons in the region who have received training in NDT as a direct result of the project. These syllabi take into account the development work done by the International Committee for Non-destructive Testing and many national training programmes, and are meant to be an objective guide to assist in the formation of NDT personnel.

6276 **(INIS-mf—10733) Development and testing of a system for partially automated evaluation of holographic interferograms in the experimental stress analysis of reactor components. Final report.** Jueptner, W.; Kreitlow, H.; Kreis, T.; Steinlein, P.; Hock, F.; Garbe, B. (Bremer Inst. fuer Angewandte Strahltechnik (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1984. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750536/JAW.

Initially the deformation fields at the side surfaces of tensile test specimens with varying internal cracks have been calculated by the method of finite elements. From these now already known surface-deformations the stresses in the interior were calculated. By a variation of the parameters it was proven, that exact deformations at the input yield the exact stress distributions at the output. A systematic error in the deformations in one direction gave a proportional error in the determined stresses. Statistical errors in the deformations propagated less than proportional, thus an error of +10% in the deformation yields an error of 2% in the determined stress. For that reason an accuracy of 5% is demanded for the deformation measurements. The determination of the stresses is noncritical, as long as the error in the deformation measurement remains less than 5%. The second substantial result: A method has been found, that with the used test specimen allows to infer from the measured surface deformations on the length of the crack by iteration. This result exceeds the original aims. To prove, that the surface-deformations can be determined sufficiently exact at adequate many points, an automated recording and evaluation of interference patterns was done by an image processing system according to the method with phase-shifted reference-wave by Jueptner. With this system deformations in a field of 1024x512 points are recorded and evaluated with an accuracy better than 5% in less than 30 minutes.

6277 **(SKI-B—86047) Inductive testing of reactor pressure vessels. Literature study.** Bergh, H. (Swedish Nuclear Power Inspectorate, Stockholm). 5 Feb 1987. 27p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750360/JAW.

With an English summary.

In Service Inspection of Reactor Pressure Vessels is mostly done with ultrasonics. Using special 2 crystal-probes good detectability is achieved for near surface defects. The problem is to detect closely spaced cracks, to decide if the defects are surface braking and, if not, to decide the remaining ligament. The purpose of this study is to investigate to what extent Eddy Current can solve these problems. Detecting surfacebreaking cracks and fields of cracks can be done using conventional Eddy Current techniques. Mapping of closely spaced cracks requires a small probe and a high frequency. Measurement of depths a larger probe, a lower frequency and knowledge of the crackfield since 2 closely spaced shallow cracks might be mistaken for one deep crack. Depths of singel cracks can be measured down to 7-8 mm. In closely spaced crackfields the depths can not be measured. The measurement is mostly based on amplitude. For not surface breaking defects the problem is to decide the ligament, i.e. the distance between surface and cracktip. To achieve good penetration a large probe, low frequency and high energy or pulsed energy is used. Ligament up to 4 mm can be measured with good accuracy. The measurements is mostly based on phase. Noise, which originates from rough surface, varied material structure and lift off, can be reduced using multi frequency mix, probe design and scanning pattern.

6278 **(UCRL—95774) Computer simulations of ballistic experiments.** Wilkins, M.L.; Reaugh, J.E. (Lawrence Livermore National Lab., CA (USA)). 23 Jan 1987. Contract W-7405-ENG-48. 29p. (CONF-8702115—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87005835/JAW.

From 3. U.S. Army Tank Automotive Command Armor conference; Monterey, CA, USA (17 Feb 1987).

The efficiency of a projectile to penetrate a target depends on the projectile velocity and shape. The material properties of the target and projectile also have important roles. The projectile penetration process is studied in three phases: transient start-up, quasi steady-state and final. Computer simulations are presented that study the effects of the various parameters taken one at a time on

the penetration of steel targets by tungsten alloy projectiles. The calculations are correlated with experimental data. 7 refs., 23 figs.

6279 (Y/DW—721) A pulsed eddy current method for examining thin-walled stainless steel tubing. Pickett, C.A.; Koerner, D.W.; Dodd, C.V.; Deeds, W.E. (Oak Ridge Y-12 Plant, TN (USA)). 31 Jul 1987. Contract AC05-84OS21400. 13p. (CONF-870691—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002294/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

A bellows was fabricated from a 12-in. section of type 321 or type 316 stainless steel tubing. In order to ensure that the bellows would survive the rigors of the production environment, it was essential that the tubing be free of all "scratch like" defects. A feasibility study was conducted to determine if an eddy current method could be developed to nondestructively examine this tubing. The problem consisted of inspecting large quantities of the thin-walled stainless steel tubing to a sensitivity level of 0.0006 in. (0.015 mm). The defects could be located on either the interior or exterior surface of the tube. The tubes were nominally 0.144 in. (3.66 mm) in diameter and approximately 0.005 in. (0.127 mm) thick. The individual length of each tube ranged anywhere from 20 to 40 in. (0.6 to 1.0 m). This report describes the feasibility testing that was conducted, along with the design and development of a pulsed eddy current instrument. The inspection capability of this instrument is also detailed.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 5934, 6051, 6083, 6257, 6387, 6388, 6655, 6895, 6896

6280 (SAND—85-0259) Operating manual for a programmable scaler/integrator chassis for neutron measurements. O'Neal, M.L.; Saxton, H.E. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002481/JAW.

Sandia National Laboratories' facilities for development testing of neutron tubes and generators utilize waveform digitizers which are computer-controlled through an industry standard computer interface. This manual describes a computer-controlled scaler/integrator neutron measurement chassis which is interface compatible. The chassis has scintillation-counting and integrator circuitry designed to work with two types of neutron probes, one that monitors 14-MeV neutrons from the DT reaction and another that monitors 2.5-MeV neutrons from the DD reaction. 6 refs., 8 figs., 1 tab.

6281 (SAND—87-2501C) Radiation hardness evaluation of thin film ferroelectric capacitors. Wrobel, T.F.; Bullington, J.A.; Schwee, L.J. (Sandia National Labs., Albuquerque, NM (USA); Krysalis Microelectronics, Albuquerque, NM (USA); Naval Surface Weapons Center, Silver Spring, MD (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-871032—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001357/JAW.

From Challenges facing government electronics in the 1990's; Orlando, FL, USA (27 Oct 1987).

Ferroelectric capacitor structures have been evaluated in total dose, dose-rate and cosmic ray environments. The capacitors were found to maintain polarization following an exposure of ~5 Mrad (Si), ~1 x 10^{11} rad(Si)/s and ~6 x 10^{8} Cf-252 fission fragments per cm^2. The capacitors show minimal degradation in the P versus E hysteresis curve following ~10 Mrad(Si), ~1 x 10^{11} rad(Si)/s and ~6 x 10^{8} Cf-252 fission fragments per cm^2. In addition, no heavy ion induced hard errors were observed for capacitor bias levels below the intrinsic breakdown voltage of 20 V.

6282 (UCRL—96262) Vacuum transmission lines for pulse sharpening and diagnostics applications. Di Capua, M.S.; Goerz, D.A.; Freytag, E.K. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-870656—47). NTIS, PC A02. Order Number DE88001878/JAW.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

We investigated the propagation of MV electrical pulses along coaxial transmission lines (TL) in vacuum with network simulations and experiments. One goal was to establish how well a 3 m-long TL would sharpen the output pulse of a relativistic electron beam accelerator. Sharpening occurs as the cathode of the TL emits electrons and the current flow forces the TL into magnetic cut-off. The other goal was to determine how well field emission must be suppressed in a TL to avoid distortion of a propagating pulse. Simulations predict a four-fold risetime improvement (8 ns to 2 ns) through magnetic insulation in a TL with an electrical length (10 ns) comparable to the risetime of the input pulse. In the laboratory we have shown a five-fold improvement (15 to 3 ns) with a velvet covered 3-m line and a 7.5 fold improvement (2 ns) when a vacuum flashover switch was incorporated between the first third and the last two thirds of the TL. Simple arguments and TL simulations suggest that even a small fraction (1 or 2%) of Child-Langmuir (CL) space charge limited emission will distort a propagating voltage pulse. This result is of particular importance when the TL is part of a voltage diagnostic system.

4209 Waste Processing Plants And Equipment

6283 (CONF-871075—8) New standards for confined spaces entry and their application on the hazardous waste site. Ogle, R.B. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000952/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Since accidents involving workers in confined spaces frequently result in death or serious injury to one or more individuals, confined spaces are viewed by safety and health professionals as one of the most dangerous occupational hazards. The frequency of occurrence of a confined space incident is difficult to calculate since no records are maintained on actual number of entries into confined spaces, but it is clear that when these events do occur, there is a high probability of death or serious injury. Confined spaces are one of the most publicized safety hazards and have received considerable attention for many years. As is the case with most occupational health or safety hazards, the first step in controlling the hazard is to recognize the conditions that would lead to the occurrence of an incident. For confined spaces, the initial step in recognition would be to clearly define the term confined space. The National Institute for Occupational Safety and Health definition described a confined space as one: which by design has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces include but are not limited to storage tanks, compartments of ships, process vessels, pits, silos, vats, degreasers, reaction vessels boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines. 6 refs.

6284 (NEI-DK—50) Psychrophilic biofilm reactors for anaerobic digestion. Spendler, F.H. (Teknologisk Inst., Taastrup (Denmark). Bioteknik). Apr 1987. 56p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750389/JAW.

Three identical fixed-bed anaerobic reactors (10 l void volume) were used to digest whey permeate at 12 deg. C, 20 deg. C and 35 deg. C. The organic load was kept constant at 7 g COD/l reactor/day in 90 days "Steady-state" operation. The overall COD-reduction at 12 deg. C was near 80% of the COD-reduction at 35 deg. C. At 20 deg. C the COD-reduction was 88% of the COD-reduction at 35 deg. C. The COD-reduction versus temperature shows a straight line. On the other hand, the specific gas production (1 gas per g COD added) and the specific methane production (1 methane pr. g COD added), versus temperature, was not a straight line. This could be explained by the fact that the solubility of gas increase with decreasing temperature. At 12 deg. C the specific methane production was 55% of the production at 35 deg. C. At 20 deg. C the specific methane production was 70% of the production at 35 deg. C. These results indicate that it is possible to

treat "cold waste water" at a low temperature with nearly the same COD-reduction as with 35 deg. C if the liquid retention time is increased, probably with 20-25%.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 5424, 6009, 6211

6285 **(BMFT-FB-T—86-232) Fireplaces in dwellings. Final report.** Hoess, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.)). Dec 1986. 482p. (In German). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88750992/JAW.

The influence of windows and interior doors with different tightness on the operation of open fireplaces and on indoor air quality had been investigated. Because of the limited permeability to air of the building's envelop not in every case an impeccable operation of fireplaces is possible, minimum joints and minimum permeability of the joints taken as a basis. However, the presence of different disadvantageous factors will not occur usually. Proposals and recommendations for ventilation and other technical measures to avoid negative situations in residential buildings have been developed. With 31 refs., 81 tabs., 198 figs..

4230 Marine Engineering

REFER ALSO TO CITATION(S) 5997

6286 **(AUC-IBT—8604) Development of applicable methods for evaluating the safety of offshore structures. Pt. 3.** Thoft-Christensen, P.; Sigurdsson, G.; Soerensen, J.D. (Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik). Apr 1986. 23p. Aalborg Universitetsbibliotek, P.O. 8200, DK-9220 Aalborg Oest, Denmark.

Structural reliability theory. Paper 17; EFP-85; EFP-86.

In a previous paper a program package called MEKBETA was described by which fundamental mechanisms and significant mechanisms in plane and space frame and lattice structures are identified automatically. In the present paper it is shown that the program package MEKBETA can be modified in such a way that interaction between e.g. the axial forces and bending moments with regard to failure (yielding) can be taken into consideration. A brief review of the mathematical theory of plasticity is given with emphasis on the limit theorems. The reliability of elasto-plastic plane frame and truss structures is discussed. Finally, the effect of the interaction between axial forces and bending moments is investigated on the basis of 3 examples. (LN).

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 6421

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 6653, 6687

6287 **(CERN—87-10) CAS CERN Accelerator School: Second general accelerator physics course. Proceedings.** Turner, S. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Jul 1987. 395p. (CONF-860975—). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88700579/JAW.

From General accelerator physics course; Aarhus, Denmark (15 Sep 1986).

The course on general accelerator physics given at Aarhus is basically a repeat of that organised by the CERN Accelerator School at Gif-sur-Yvette, Paris in September 1984 and whose proceedings were published as CERN Yellow Report 85-19 (1985). However, the opportunity was taken to improve or extend certain subjects while introducing new ones and it is these which are included in the present proceedings. The lectures treated here include accelerator optics, insertions, image and space charge forces, neutralisation, diagnostics and intra-beam scattering while the seminar programme includes a number of specialised accelerator topics. Reports on a separate series of seminars organised by the University of Aarhus, Denmark, and devoted to advanced technology arising from general accelerator physics are also included, as well as errata to CERN 85-19.

6288 **(JINR—R-10-86-774) Program for calculating the hydrogen concentration profile by energy spectra of recoil protons.** Il'khamov, R.A.; Li Zen Kho; Machajdik, D.; Osetinskij, G.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700544/JAW.

The method of hydrogen profile determination, using 2-3 MeV /sup 4/He ion beams from the Van de Graaff generator of JINR, based on the modeling the proton recoil spectra and subsequent their comparison with experimental ones is described. The energy straggling of /sup 4/He ions and protons, and energy resolution were taken into account in the model spectra. For this purpose the FORTRAN code has been written with RSX-11M-PLUS system. 3 refs.; 7 figs.; 2 tabs.

4301 Design, Development, And Operation

6289 **(CERN—87-09) Introduction to the theory of linear accelerators.** Lapostolle, P. (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Jul 1987. 121p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700578/JAW.

From the beginning, the development of linear accelerators has followed a number of different directions. This report surveys the basic ideas and general principles of such machines, pointing out the problems that have led to the various improvements, with the hope that it may also aid further progress. After a brief historical survey, the principal aspects of the theory are covered in some detail: phase stability, focusing, radiofrequency accelerating structures, the detailed calculation of particle dynamics, and space-charge effects at high intensities. These developments apply essentially to proton and ion accelerators, and only the last chapter deals with a few aspects relative to electrons.

6290 **(CERN-EP—86-210) Energy and luminosity requirements for the next generation of linear colliders.** Amaldi, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 16 Dec 1986. 11p. (CONF-8608148—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900057/JAW.

From Symposium on critical issues in the development of new linear colliders; Madison, WI, USA (27 Aug 1986).

This paper discusses the theoretical particle models that the next generation of linear colliders will help to verify. In particular this paper looks at the standard model and associated particles. (LSP)

6291 **Large scale positron production for physics needs via fission reactors.** Ottewitte, E.H. (Idaho National Engineering Laboratory (INEL), P.O. Box 1625, Idaho Falls, ID 83415). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 209-221(5 May 1987). (CONF-8608123—). Contract AC07-76ID01570.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

Condensed matter physics, antimatter factories, and large lepton colliders constitute three generic physics areas which seek more intense positron beams. Radioactive nuclei have long served as positron sources. BNL has developed a technique which combines their neutron activation in a high-flux research reactor with subsequent reconstitution as a self-moderating and -collimating, positron-emitting crystal. Examination of the reactor physics indicates that little more can be achieved through higher neutron fluxes or different nuclide targets; however, a real prospect exists for multi-magnitude increase through large-scale volume irradiation in "test

reactors". There remains to develop a large-scale technique to process large-volume positron sources into a compact beam.

6292 **Optically pulsed electron accelerator for laser.** Fraser, J.S.; Sheffield, R.L. (to Department of Energy, Washington, DC (USA)). British Patent 2175738/A/. 3 Dec 1986. Priority date 20 May 1985, United States of America (USA), 7p. Patent Office, 25 Southampton Buildings, London, WC2A 1AY.

US priority 736033.

An optically pulsed electron accelerator can be used as an injector for a free electron laser and comprises a pulsed light source, such as a laser, for providing discrete incident light pulses. A photoemissive electron source emits electron bursts having the same duration as the incident light pulses when impinged upon by same. The photoemissive electron source is located on an inside wall of a radiofrequency-powered accelerator cell which accelerates the electron burst emitted by the photoemissive electron source. In modifications the pulsed light source enters the cell from a top opening or by impinging on the photoemissive electron source located in an end wall of the cell.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 6289, 6320, 6993, 6994, 6995, 6996

6293 **(BNL—40268) Choice of parameters for linear colliders in multi-bunch mode.** Claus, J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 30p. (CONF-8706147—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87013648/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

The energy efficiency of a linear collider in multi-bunch mode is calculated for the case that the bunches in each of the two interacting beams are identical in all interaction points, a configuration which can be realized by taking advantage of the beam-beam effect between beams of opposite electric charge. The maximization of the efficiency is discussed, the maximum appears to increase nearly linearly with beam brightness and accelerating gradient, and about quadratically with the length of the ir. The optimum operating frequency for the linacs increases also, while the pulse repetition rate and the beam current needed for fixed luminosity, decrease. The increasing brightness and the decreasing current needed for higher efficiency lead to smaller transverse spotsizes in the crossing points; this imposes tighter tolerances on the relative transverse coordinates of the two beam-axes. Pillbox or similar resonators, excited in the TM01 mode, may be preferable to quadrupoles for transverse focusing, at the high frequencies and gradients that seem desirable, particularly in the final focus. 4 refs., 7 figs.

6294 **(FNAL-TM—1490) Tracking results using a standard cell lattice.** Gelfand, N.M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 42p. NTIS, PC A03. Order Number DE88002841/JAW.

This is a summary of results obtained by tracking a single particle through a lattice composed of a r.f. cavity and standard FODO cells. The lattice also includes two families of sextupoles for controlling the chromaticity. The parameters of the cells, i.e. their length and phase advance, closely resemble those of the Fermilab Main Ring or the Tevatron. We therefore have a model lattice which is similar to that of those accelerators but without the straight sections present in the actual machines. It is hoped that the simplified model used will exhibit the salient features of the actual accelerator but will be simpler to understand. 8 figs., 1 tab.

6295 **(IFVE-OUNK—86-194) Electromagnetic radiation of a beam in a synchrotron in short magnets field.** Smolyakov, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700651/JAW.

Electromagnetic radiation of a beam in a synchrotron with the azimuthal sharply inhomogeneous magnetic field is considered. Spectral-angular characteristics of electromagnetic radiation of the ultrarelativistic charged particle beam in the magnetic field of plane square short magnets are obtained and analysed in the dipole approximation. The magnetic field is calculated in the approximation of infinite magnetic permeability of the ferromagnet, as well as for shutters being homogeneously magnetized permanent magnets (e.g., on the basis of rare earth elements). The beam is supposed to be thin crossing the gap center between poles of the magnetic system. Decrease of the gap between the poles is shown to lead to the exponential growth of radiation spectral density. Possibility of monitoring the proton beam using this radiation is considered. 19 refs.; 4 figs.

6296 **(JINR—R-9-86-586) On a possibility of ion acceleration up to high energies in a high-current electron beam.** Bonch-Osmolovskij, A.G.; Reshetnikova, K.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700532/JAW.

Submitted to the Organizing Comittee of the 13. International conference on high-energy particles accelerators (Novosibirsk, Aug. 1986).

A possibility of accelerating ions up to relativistic velocities in the high-current electron beam is investigated. By analytical and numerical methods of solving self-consistent system of equations in hydrodynamical approximation it is shown, that external HF-generator can excite in the structure with the beam fast Langmuir wave of high intensity. Phase velocity of this wave is larger than that of electrons but less than the velocity of light. Ion acceleration rate may constitute 30-40 MeV/m under the following electron beam parameters: current ~ 1 kA, energy-250-300 keV. The change of phase velocity with the ion velocity increase may be conducted through changing such geometric parameters as waveguide wall dielectric coating thickness. Basically important feature of the given method, consisting in acceleration of high-current ion beam (J/sub i/≅IA), is retained under ion injection from section with slow wave into section with fast wave. This offers a possibility of beam colliding for example, pp, pd etc., with the energy of 2 x 10 GeV and higher with a consi derable luminosity. 3 refs.; 2 figs.

6297 **(KFTI—87-3) Ion beam acceleration in magnetic insulation systems.** Karas', V.I.; Mukhin, V.V.; Naboka, A.M.; Novikov, V.E. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700562/JAW.

Charged particle motion in the magnetic field of cusped geometry and in the stationary electric field both at one-particle approximation and if the proper particle fields being accounted, is studied. Effect of transverse electron drifts on modification of external magnetic fields, compensated ion beam transport through casped geometry in the axisymmetric system and processes of charge compensation of a ion beam at the accelerating gap by an additional electron beam or a plasma are considered. 16 refs.; 11 figs.

6298 **(KFTI—87-6) Experimental research of electron beam instability on the Doppler anomalous effect.** Gorozhanin, D.V.; Ivanov, B.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700565/JAW.

Beam instability caused by the Doppler anomalous effect (DAE) at electron beam interaction with the decelerating electrodynamic system (a resonator with a single-thread spiral and a resonator with a space-periodic structure) placed in the external homogeneous field are studied experimentally to investigate main mechanisms of instability of charged particle beams. Such general properties of DAE as resonance conditions for instability excitation, increase of the internal energy of oscillators (Larmor and Langmuir) during radiation, energy ratios for slow cyclotron and plasma waves of an electron beam are studied. Good agreement between experimental and theoretical results is obtained. 9 refs.; 6 figs.

6299 **(KFTI—87-7) Experimental evaluation for efficiency of excitation slow plasma and cyclotron waves in collective accelerators.** Ivanov, B.I.; Gorozhanin, D.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700566/JAW.

Experiments on excitation of show cyclotron and plasma wawes (SCW, SPW) at electron beam excitation with the decelerating electro-dynamic system (a resonator with a spiral and a resonator with a space-periodic structure) in the external longitudinal homogeneous magnetic field are carried out to investigate methods of ion acceleration by charge density waves (CDW) of the electron beam. Efficiency of SCW and SPW excitation is determined and it is shown that it is detected by the fact, which accounts the relation of energy components of CDW between each other - active going to acceleration and HF-radiation, and reactive, stored in oscillating motion of beam particles - and decreases with the growth of CDW deceleration. Universality of multipliers of v/sub i//(v/sub e/-v/sub i/), v/sub p//(v/sub e/-v/sub p/), v/sub p//v/sub e/ type (where v/sub e/, v/sub i/ - electron and ion rates, v/sub p/ - phase rate of CDW) entering the expression of efficiency of ion acceleration by electron beams, is marked. 11 refs.; 3 figs.

6300 **(KFTI—87-11) Nonlinear effects of dipole magnet edge field in charged particle cyclic accelerators and storage rings.** Bulyak, E.V.; Efimov, S.V.; Tarasenko, A.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700737/JAW.

It is well-known that nonlinear effects influence the process of slow resonance extraction of charged particles from accelerators and storage rings. Nonlinear effects caused by boundary fields of dipole magnets are theoretically considered. Dependence of betatron oscillation frequencies on their amplitudes, characteristics of the boundary field and betatron functions of the facility is determined. The frequency of radiation oscillations is shown to remain the same, and vertical - to grow with the amplitude increase. Nonlinear resonances which can be excited by the boundary fields are considered. Estimations of the theory are confirmed by the results of experimental determination of nonlinear characteristics of betatron oscillations carried out at N-100 storage ring of KPTI. 10 refs.; 3 figs.

6301 **(LBL—23168) Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.** (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 46p. NTIS, PC A03. Order Number DE87013971/JAW.

For this report we have collected the papers presented by the HIFAR group at the IEEE Particle Accelerator Conference held in Washington, DC, on March 16-19, 1987, which essentially coincides with the end of the reporting period. In addition, we report on research to determine the cause of the failures of Re-X insulator that are used as the high-voltage feed-through for the electrostatic quadrupoles on MBE-4. This report contains papers on the following topics: LBL multiple beam experiments, pulsers for the induction linac experiment (MBE-4), HIF insulator failure, experimental measurement of emittance growth in mismatched space-charge dominated beams, the effect of nonlinear forces on coherently oscillating space-charge dominated beams, space-charge effects in a bending magnet system, transverse combining of nonrelativistic beams in a multiple beam induction linac, comparison of electric and magnetic quadrupole focusing for the low energy end of an induction-linac-ICF driver. Eight individual papers have been indexed separately. (LSP)

6302 (LBL—23168, pp 14-16) **Experimental measurement of emittance growth in mismatched space-charge-dominated beams.** Tiefenback, M.G. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

Using the Single Beam Transport Experiment (SBTE) at LBL, we have measured the emittance of a well-matched 4.6-mA beam of 122-keV Cs^+ to be conserved from injection into through exit from an 80-lens segment of the AG focussing channel. We then mismatched the beam into the same channel such that the maximum (minimum) radius of the beam at the midplane between lenses was about 1.5 (0.5) times the former value. We caused mismatches in the envelope of the beam in both transverse dimensions (labeled a and b, in modes both symmetric ($\delta a = \delta b$) and antisymmetric ($\delta a = -\delta b$). We found the mismatch amplitude to decay during the beam transit through the channel for both modes of mismatch, although more so for the antisymmetric mode. We also found the emittance of the symmetrical mismatched beam to be the same as for the matched beam, while the emittance of the antisymmetrically mismatched beam grew by as much as a factor of four over that for the matched beam. 4 refs.

6303 (LBL—23168, pp 22-24) **Space charge effects in a bending magnet system.** Lee, E.P.; Close, E.; Smith, L. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

In order to examine problems and phenomena associated with space charge in a beam bending system, the beam dynamics code HICURB has been written. Its principal features include momentum variations, vertical and horizontal envelope dynamics coupled to the off-axis centroid, curvature effect on fields, and images. Preliminary results for an achromatic lattice configuration are presented. 5 refs.

6304 **(LBL—23798) Phase control of the microwave radiation in free electron laser two-beam accelerator.** Goren, Y.; Sessler, A.M. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 9p. (CONF-8706147—12). NTIS, PC A02. Order Number DE88001460/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

A phase control system for the FEL portion of Two-Beam Accelerator is proposed. The control keeps the phase error within acceptable bounds. The control mechanism is analyzed, both analytically in a "resonant particle" approximation and numerically in a multi-particle simulation code. Sensitivity of phase errors to the FEL parameters has been noticed.

6305 **(SLAC-PUB—4430) Beam dynamics issues for linear colliders.** Ruth, R.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1987. Contract AC03-76SF00515. 13p. (CONF-8706147—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002567/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

In this paper we discuss various beam dynamics issues for linear colliders. The emphasis is to explore beam dynamics effects which lead to an effective dilution of the emittance of the beam and thus to a loss of luminosity. These considerations lead to various tolerances which are evaluated for a particular parameter set.

6306 **Variation of the dispersion function, momentum compaction factor, and damping partition numbers with particle energy deviation.** Delahaye, J.-P.; Jaeger, J. (Stanford Linear Accelerator Center, Menlo Park, CA, USA). *Particle Accelerators;* **18**: No. 3, 183-201(Feb 1986). Contract AC03-76SF00515.

Exact analytical expressions for the periodic solution and transportation of the dispersion function and its perturbation with energy deviation are derived and found to be valid for any order of the expansion; the solution depends on two specific integrals only. These integrals are related to the driving terms of the particular perturbations and are exactly solved for the first- and second-order expansions, including magnetic elements up to second order. The variation with particle energy of two particularly important ring parameters, the momentum compaction factor and the damping partition numbers, is analyzed, and their dependence on the perturbation of the dispersion function is emphasized. These results are then applied to a typical machine to illustrate the importance of the effects due to magnets with small bending radius and due to sextupoles. As the results demonstrate, none of the contributing terms should be neglected.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 6291, 6294, 6295, 6684

6307 (BNL—40353) Acquisition of powder diffraction data with synchrotron radiation. Cox, D.E.; Toby, B.H.; Eddy, M.M. (Brookhaven National Lab., Upton, NY (USA); Union Carbide Corp., Tarrytown, NY (USA). Central Scientific Lab.; California Univ., Santa Barbara (USA). Dept. of Chemistry). 1987. Contract AC02-76CH00016. 32p. (CONF-8708175—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002208/JAW.

From International symposium on X-ray powder diffractometry; Fremantle, Australia (20 Aug 1987).

During the past year, a dedicated triple-axis powder diffractometer has been in routine operation at the Brookhaven National Synchrotron Light Source as a user-oriented facility. The diffractometer is designed to allow easy interchange between energy-dispersive and monochromatic beam experiments. In the latter mode of operation, high resolution data have been collected for a variety of samples with the use of the crystal-analyzer technique, and in several cases these data sets have been used successfully for structure solution and Rietveld refinement. Several aspects of data acquisition at a synchrotron beam-line are described, and some of the different types of scattering geometry which have been used are discussed. Simple expressions are given for the instrumental resolution function expressed as the angular variation of peak widths for each of these. The peak shapes observed for a reference sample of Si on the present triple-axis instrument are well-described by the convolution of Gaussian and Lorentzian functions, and the angular dependence of the Gaussian component is in excellent agreement with the corresponding calculated instrumental function. One of the most important considerations for each type of experiment is the necessary compromise between intensity and resolution over a wide range of scattering angles, and some of the available options will be discussed. In particular, the use of Ge(440) and LiF(400) analyzer crystals gives a focussing minimum at relatively high angles ($2\Theta \approx 50^0$ at 1.54A), a highly desirable feature for Rietveld analysis of complex structures. Absolute intensities from reference samples of Si and CeO_2 are calculated for these and several other scattering configurations involving both flat-plate and capillary geometry to illustrate this compromise. 26 refs., 3 figs., 3 tabs.

6308 (BNL—40374) X-ray microscopy using collimated and focussed synchrotron radiation. Jones, K.W.; Kwiatek, W.M.; Gordon, B.M.; Hanson, A.L.; Pounds, J.G.; Rivers, M.L.; Sutton, S.R.; Thompson, A.C.; Underwood, J.H.; Giauque, R.D. (Brookhaven National Lab., Upton, NY (USA); Chicago Univ., IL (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract AC02-76CH00016;AC03-76SF00098. 11p. (CONF-8708150—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002120/JAW.

From 36. annual Denver X-ray conference; Denver, CO, USA (3 Aug 1987).

X-ray microscopy is a field that has developed rapidly in recent years. Two different approaches have been used. Zone plates have been employed to produce focused beams with sizes as low as 0.07 μm for x-ray energies below 1 keV. Images of biological materials and elemental maps for major and minor low Z have been produced using above and below absorption edge differences. At higher energies collimators and focusing mirrors have been used to make small diameter beams for excitation of characteristic K- or L-x rays of all elements in the periodic table. The practicality of a single instrument combining all the features of these two approaches is unclear. The use of high-energy x rays for x-ray microscopy has intrinsic value for characterization of thick samples and determination of trace amounts of most elements. A summary of work done on the X-26 beam line at the National Synchrotron Light Source (NSLS) with collimated and focused x rays with energies above 4 keV is given here. 6 refs., 5 figs., 1 tab.

6309 (FNAL-TM—1482) An investigation into flow regimes for two-phase helium flow. Theilacker, J.C.; Rode, C.H. (Fermi National Accelerator Lab., Batavia, IL (USA); Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). Oct 1987. Contract AC02-76CH03000. 9p. (CONF-8706125—18). NTIS, PC A02/MF A01. Order Number DE88002834/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

The Tevatron accelerator at Fermilab incorporates long two-phase helium passages. During magnet design, the generalized flow map of Baker was used to predict homogeneous flow. Longer than expected magnet time constants led to this investigation. The importance of predicting the flow regime has been amplified with the advent of non-horizontal accelerator designs. A test setup was constructed at Fermilab to investigate two-phase helium flow regimes for conditions practical in accelerator designs. The setup consisted of a standard Tevatron satellite refrigerator, subcooling dewar, heater, 35 m long transfer line, and a specialized end box. A knife blade on the midplane of the transfer line diverted the flow from the upper and lower halves of the pipe to separate vessels in the end box. The amount of liquid above and below the plane was measured at various total mass flow rates and liquid percentages. The results show that stratified flow occurs at much higher liquid percentages than predicted by the Baker diagram (several orders of magnitude). We were not able to produce high enough steady state flows to find a boundary to a homogenous flow regime. Stratified flow occurred over all practical conditions for long accelerator magnet systems.

6310 (FNAL-TM—1483) Cryogenic testing at the SSC [Superconducting Super Collider] string test facility. Theilacker, J.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 8p. (CONF-8706125—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002835/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

A multipurpose cryogenic testing facility was constructed and became operational in 1986 at Fermilab. It consists of a standard Tevatron satellite refrigerator and 450 liter subcooling dewar housed within a building adjacent to a Tevatron refrigerator. A 11 m by 15 m high bay contains power supplies necessary to power Superconducting Super Collider (SSC) magnets, a cryogenic feedcan to interface the refrigerator to the magnet string, and an area for testing Tevatron components. Currently, a 120 m, 4 m diameter tunnel has been constructed off the high bay to house a half cell of SSC Design D magnets. Capabilities have been made to extend the tunnel up to 1 km in length. Testing at the facility includes SSC long string test, heat leak measurement, cold compressor tests, turbine test, and cold leak checking.

6311 (FNAL-TM—1484) Online monitoring of laser-pulses using the GPIB-interface of a Tektronix 2430 Digital Storage Oscilloscope. Verluyten, L.; Peters, M.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002836/JAW.

One of the monitoring aspects of holography at the 15 foot Bubble Chamber is the online checking of the lightoutput of the JK2000 ruby laser. Ideally the lightoutput should be a squared pulse in time. Spikes, pre- and postlasing (i.e., lasing before and after the squared pulse) can have a negative influence on the holograms. The scheme for monitoring the lightoutput is discussed in this paper as well as the programming codes and experimental setup necessary to enhance the holography. 1 fig.

6312 (FNAL-TM—1485) Tests of cold helium compressors at Fermilab. Peterson, T.J.; Fuerst, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 9p. (CONF-8706125—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002837/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

Fermilab has tested two cold helium compressors for possible installation in the satellite refrigerator buildings of the Tevatron cryogenic system. Operating conditions required to obtain an overall Tevatron energy upgrade from 900 to 1000 GeV are (for each of 24 machines): 52 g/s mass flow rate, 0.7 atm inlet pressure, 1.4 atm exhaust pressure. Acceptable efficiency is in the 60% range. Both Creare, Inc., and Cryogenic Consultants, Inc. (CCI), have supplied units for evaluation. The Creare machine is a high speed centrifugal pump/compressor which yielded 60% adiabatic efficiency (including an approximately 20 watt heat leak) with a 1.0 atm inlet pressure and 55 g/s flow rate. Certain mechanical difficulties were present, chiefly the device's inability to withstand two-phase flow. CCI supplied a reciprocating unit which, after initial testing and modification, achieved 59% efficiency with an approximate 35 watt heat leak at a 0.7 atm inlet pressure and 48 g/s flow rate. Although the device lacks the smooth, quiet operating characteristics of a turbomachine, it has endured mechanically throughout testing and is entirely insensitive to two-phase flow.

6313 **(IFVE-OEA—86-88) Gain-programmable amplifier modules.** Grigor'ev, V.P.; Dubasov, Yu.B.; Krendelev, V.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700630/JAW.

Two types of U-138, U-139 gain-programmable amplifiers constructed in the SUMMA modular system and which are a part of the equipment for superconducting magnet parameters monitoring are described. The U-138 module represents a four-channeled gain-programmable amplifier designed for measuring superconducting magnet (SP-magnet) coil elements voltage, where voltage up to 1000 V can arise during transition of this magnet from the superconducting state to normal (quench-transition), being a part of the data acquisition and processing system. The U-139 module represents a two-channeled gain-programmable amplifier designed for operation with low-ohmic transducers (measuring shunts), being a part of the data acquisition and processing systems. Main characteristics of the amplifiers and methods for their controlling by the gain factor are given. 3 refs.; 1 fig.; 3 tabs.

6314 **(ITEF—146(1986)) Formation of an intense beam of heavy ions from a laser-produced plasma.** Barabash, L.Z.; Krechet, K.I.; Shumshurov, A.V.; Sharkov, B.Yu.; Bykovskij, Yu.A.; Khajdarov, R.T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki; Moskovskij Inzhenerno-Fizicheskij Inst., USSR). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700685/JAW.

Disruption conditions for a non-stationary plasma flux produced under powerful laser radiation focusing on a solid target are obtained. A laser forinjector of heavy (A $\sim$ 200 a.e.m.) multicharged ions (Z=1-9) is developed on the base of a two-grid plasma diode; a heavy ion beam with total current of $\sim$ 200 mA, pulse duration of 10-30 μs and phase volume of $\sim$ 2x$\sqrt{}$ Zx10/sup -2/ cm x mrad is produced; monitoring of ion beam parameters is adjusted. The results obtained point out ways of using the laser forinjector in different types of accelerating systems. 9 refs.; 11 figs.; 2 tabs.

6315 **(JINR—13-86-602) Variation of parameters of vacuum conditions in large-volume chamber when pumping out using oil-vapor diffusion and magnetic sputter-ion pumps.** Glazov, A.A.; Kim Cher Kho; Kondrat'ev, V.V.; Shakun, N.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700705/JAW.

Submitted to the Organizing comittee of the 7. Czhekhoslovakian conference on electronics and vacuum physics, ChSSR, Sep 1985 g. .

The results of mass-spectrometric studies of residual gas in a chamber with rubber gaskets when pumping out using oil-vapor diffusion and magnetic sputter-ion pumps are presented. The dynamics of pumping out process and the effect of liquid nitrogen baffle upon this process is considered. It is shown that under these conditions the concentration of organic molecules in residual gas is approximately the same when pumping out by a sputter-ion pump and a diffusion one with nitrogen baffle. It is shown that using diffusion pumps with powerful nitrogen baffles may improve vacuum conditions in Dubna synchrocyclotron. 1 ref.

6316 **(JINR—R-13-86-593) Methods for determining mean momentum and composition of high-energy charged particle beam.** Abramyan, Kh.U.; Khudaverdyan, A.G.; Khachaturyan, M.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700552/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A method for approximated calculation of μ-meson admixture in high-energy π/sup +-/-meson beams (P/sub π/ >> m/sub π/) is proposed. The calculation results agree well with the data obtained using the threshold gaseous Cherenkov counter. A method for determining the mean momentum and charged particle beam composition by means of the threshold Cherenkov counter is also described. The method proposed provides for a better statistical accuracy and permits to eliminate statistical errors in determining the beam mean momentum and composition. 6 refs.; 3 figs.; 1 tab.

6317 **(JINR-R—9-86-139) DTs-1 deuteron cyclotron accelerating system.** Glazov, A.A.; Zaplatin, E.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700722/JAW.

Submitted to the Organizing comittee of the 23. European conference on cyclotron progress, VNR, May 1986 g. .

Calculation of the main parameters of the accelerating system of the DTs-1 deuteron cyclotron for designed energy 1 MeV/turn is performed. The accelerating system is a half-wave delta-resonator with TEM-wave with vertical resonance lines. The lost power at 250 kV peak voltage will be about 45 kW, resonance frequency 75 MHz. Theoretical results, obtained analytically and using numerical programs, were compared with experimental data of investigation of the 1:2 scale model of the Δ-resonator. 5 refs.; 12 figs.

6318 **(JINR-R—9-86-601) On the matching of the phase volume of a transported charged particle beam by a doublet of qudrupole lenses.** Yudin, I.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700723/JAW.

Submitted to the 13. Internationl conference on high energy particle accelerators, Novosibirsk, 7-11 Aug 1986 g. .

The problem of matching the phase volume of a transported beam is commonly solved by nonlinear programming methods. Writing a system of matching equations that is transcendental, one can turn to the following stage: its solution by direct numerical methods. In this paper the systems of matching equations reduced to one equation with one unknown by means of successive analytical transformations. This is achieved by the corresponding substitution of the variables. The last equation is solved on a computer. As a result, such characteristics as drift lengths, lengths and gradients of magnetic lenses are written analytically depending on the chosen vector of the parameters and the unknown indicated. The formulas obtained are realized as a FORTRAN program on the CDC-6500 computer. In the man-machine dialogue this program allows one to choose the most economical version of the calculated matching structure. The described method was applied for calculation of beam injection channel of the SPIN superconducting synchrotron for 1.5 GeV protons. Geometrical and magnetic characterstics of the beam transport system under study are presented for the version conclusively chosen. 11 refs.

6319 (JINR-R—10-86-751) MICRO system for control, acquisition and processing of experimental data. Dudnikov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700724/JAW.

The "Micro" on-line module system (MS) for experimental data control, acquisition and processing is described. The "Micro" system is designed for developing the ionization electron-beam method, for construction and improvement of the cryogenic ionizers of the "Cryon" type. The "Micro" MS is made in the CAMAC standard and besides a standard crate highway contains two types of additional highways general: (global) and local for every microcomputer placed in the crate. The transmission of the "Micro" MS increases 5-10 times in comparison with the MS analogous in composition, operating in the CAMAC standard. The first experiments studying X-ray radiation at the "Cryon-2" ionizer have shown advisability of the presence of several highways in the "Micro" MS. 11 refs.; 4 figs.

6320 (LA-UR—87-3340) A nonlinear analysis of the EHF booster. Colton, E.P.; Shi, D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 14p. (CONF-8710186—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001847/JAW.

From European Hadron Facility workshop; Santa Margherita, Italy (4 Oct 1987).

We have analyzed particle motion at 1.2 GeV with assumption of nonlinearities arising from non-linear space charge forces and from the lattice sextupoles which are tuned to cancel the machine chromaticity. In the first case the motion is as expected and there are no problems as long as the x and y betatron tunes are separated by an integer or more. In the second case the motion is stable so long as the betatron amplitudes do not exceed values corresponding to beam normalized emittance of 100 mm-mr; when this occurs the effects of fifth-order betatron resonances are observed. 3 refs.

6321 (LBL—23168, pp 10-12) Pulsers for the induction linac experiment, MBE-4. Gough, D.; Brodzik, D.; Faltens, A.; Pike, C.; Stoker, J. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

The MBE-4 proof-of-principle experiment uses an induction linac to accelerate four Cs^+ beams from injection at 200 kV to almost 1MV. When completed in the summer of 1987 it will be 17.2 meters long and have 24 acceleration gaps and 6 diagnostic gaps. Careful tailoring of the accelerating voltage waveforms at each gap is required to accelerate the beam, amplify the current and provide longitudinal focusing. The ideal voltage waveforms required at the first 4 gaps are almost triangular with an amplitude of about 20 kV and an approximate width of 3 μsec, becoming flatter and shorter with an amplitude of 30 kV at subsequent gaps as the beam current increases and the pulse width narrows. Pulser voltage waveforms at each gap are adjusted in both amplitude and firing time in conjunction with beam experiments to determine the required voltage waveforms of the subsequent pulsers. Existing cores and previous experience with thyratron pulsers provided the basis for the pulsers for the first half of the machine. During this fabrication period, additional cores and spark gap pulsers capable of generating higher voltages than the thyratron pulsers became available and a combination of both types of pulser will be used to complete the apparatus. 8 refs.

6322 (LBL—23168, pp 13) HIF [heavy ion fusion] insulator failure. Kennedy, K. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

This paper discusses the weld failure of the HIF insulators and suggests ways to remedy these problems. (LSP)

6323 (SAND—87-2345C) Recirculating Linear Accelerator (RLA) injection experiments. Haworth, M.D.; Smith, D.L.; Bennett, L.F.; Hasti, D.E.; Rienstra, W.W.; Lucero, S.J. (Sandia National Labs., Albuquerque, NM (USA); Science Applications International Corp., Albuquerque, NM (USA); Diversus, Inc., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 7p. (CONF-8709146—21). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000930/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

Recirculating an electron beam in phase with a repeating accelerating-cavity voltage is a technique for producing a compact, high gradient, high current (> 10 kA), linear induction accelerator. We are conducting experiments on a racetrack configuration with an ion focus regime (IFR) electrostatic channel created by a 300-V, 800-mA e-beam guided with a 200-G magnetic field in low pressure (0.2 to 0.4 mTorr) argon gas. Two inherently low impedance, radial, dielectric cavities are being operated in a single-pass mode. The isolated Blumlein injector cavity produces a 2.0-MV, >10-kA, 25-ns duration electron beam, and the ET-2 accelerating cavity generates an approximately 1.5-MV repeating waveform to post-accelerate the beam on four passes. The immediate area of interest is how to efficiently couple the beam onto the IFR channel from the injector which is external to the racetrack. We summarize our recent attempts to use a wire zone coupling scheme and our initial evaluations of the injector geometry to produce a lower emittance electron beam that will aid in future coupling studies. This discussion also includes near-term experimental plans for transporting the injected beam to the IFR channel.

6324 (SAND—87-2398C) DELPHI accelerator: First prototype (PTO). Lancaster, K.T.; Poukey, J.W.; Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-8709146—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002114/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

The PTO (first order prototype) accelerator, is a test-bed being built to address various pulsed power and beam transport issues relevant to a compact, linear-induction accelerator. The compact size of the PTO accelerator is attributable to the high frequency of operation that minimizes the ferrite needed for inductive isolation. PTO will consist of an 800-kV injector to generate an electron beam (1-kA) and two, 200-kV induction cavities to post-accelerate the beam. A driving mode which uses a high frequency bipolar waveform will enable the study of diode beam dynamics and characterization of accelerating cavity performance. A second driving mode using a multi-microsecond ringing waveform will allow the study of plasma closure rates in the diode and the accelerating cavities. The design of the injector and post-accelerating cavities are presented together with numerical simulations of particle trajectories. 2 refs., 4 figs.

6325 (UCID—21179) Thermal damage study of beryllium windows used as vacuum barriers in synchrotron radiation beamlines. Holdener, F.R.; Johnson, G.L.; Karpenko, V.P.; Wiggins, R.K.; Cerino, J.A.; Dormiani, M.T.; Youngman, B.P.; Hoyt, E.W. (Lawrence Livermore National Lab., CA (USA)). 17 Sep 1987. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002655/JAW.

An experimental study to investigate thermal-induced damage to SSRL-designed beryllium foil windows was performed at LLNL's Laser Welding Research Facility. The primary goal of this study was to determine the threshold at which thermal-stress-induced damage occurs in these commonly used vacuum barriers. An Nd:Yag pulsed laser with cylindrical optics and a carefully designed test cell provided a test environment that closely resembles the actual beamline conditions at SSRL. Tests performed on two beryllium window geometries, with different vertical aperture dimensions but equal foil thicknesses of 0.254 mm, resulted in two focused total-power thresholds at which incipient damage was determined. For a beam spot size similar to that of the Beamline-X Wiggler Line, onset of surface damage for a 5-mm by 25-mm aperture

window was observed at 170 W after 174,000 laser pulses (1.2-ms pulse at 100 pps). A second window with double the vertical aperture dimension (10 mm by 25 mm) was observed to have surface cracking after 180,000 laser pulses with 85 W impinging its front surface. It failed after approximately 1,000,000 pulses. Another window of the same type (10 mm by 25 mm) received 2,160,000 laser pulses at 74.4 W, and subsequent metallographic sectioning revealed no signs of through-thickness damage. Comparison of windows with equal foil thicknesses and aperture dimensions has effectively identified the heat flux limit for incipient failure. The data show that halving the aperture's vertical dimension allows doubling the total incident power for equivalent onsets of thermal-induced damage.

6326 **(UCRL—96852) Design of an electronically tunable millimeter wave Gyrotron Backward Wave Oscillator.** Caplan, M. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 4p. (CONF-871210—4). NTIS, PC A02. Order Number DE88002467/JAW.

From 12. annual international conference of the Institute of Electrical and Electronics Engineers on infrared and millimeter waves; Orlando, FL, USA (14 Dec 1987).

A non-linear self-consistent computer simulation code is used to analyze the saturated output of the Gyrotron Backward Wave Oscillator (Gyro BWO) which can be used as a tunable driver for a 250 GHz FEL amplifier. Simulations show that the Gyrotron BWO using a Pierce/Wiggler gun configuration can produce at least 10 kW of microwave power over the range 249 GHz to 265 GHz by varying beam voltage alone.

6327 **Generation of GW VHF power pulses with a magnetically swept e beam and inverse e beam diodes.** Johnson, D.J.; Lockner, T.R.; Poukey, J.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 62: No. 12, 4653-4661(15 Dec 1987). Contract AC04-76DP00789.

The concept of converting a multi-kA relativistic e beam into an ultrahigh-power rf pulse with a magnetically swept e-beam switch is studied. Two short VHF pulses are created by rapidly switching a 60-ns, 900-keV, 15-kA e beam between a pair of inverse e-beam diodes. The switching is done by a transverse 500-G, sinusoidal B field, oscillating at 50 MHz. The e-beam pulses are transported 1.6—4.6 cm in vacuum and ballistically or magnetically focused onto the collectors of the inverse diodes. The inverse diodes extract electrical energy from the deflected e-beam pulses and transport the energy to resistive loads that varied between 30 and 130 Ω. Numerical simulations of the e-beam transport with self-electric and magnetic fields are performed that show the sources of electrical inefficiency. These occur because the e beam is near the space-charge limit during transport. Peak unipolar powers of 2.0 and 0.5 GW are coupled to the resistive loads for the ballistically and magnetically transported e-beam geometries, respectively.

6328 **Design procedure for acceleration and bunching in an ion induction linac.** Kim, C.H.; Smith, L. (Lawrence Berkeley Lab., CA, USA). *Particle Accelerators;* 18: No. 2, 101-113(Dec 1985).

The paper concerns a design procedure for acceleration and bunching in an ion induction linac using I) a current self-replicating scheme, and II) a line charge density self-replicating scheme. The design is tested with a computer code for its longitudinal dynamics, including space charge effects, deviations from ideal accelerating voltage waveforms, and module impedances. These results are used to make adjustments to the design. An application of the procedure to the planned High-Temperature experiment is described.

6329 **Theoretical and experimental investigation of the interaction impedances and Q values of the accelerating cells in the Advanced Test Accelerator.** Briggs, R.J.; Birx, D.L.; Caporaso, G.J.; Neil, V.K.; Genoni, T.C. (Lawrence Livermore National Lab., CA, USA; Military Academy, West Point, NY, USA). *Particle Accelerators;* 18: No. 1, 41-62(Nov 1985). Contract W-7405-ENG-48.

Measured values of the interaction impedance and Q values for electromagnetic resonances in the accelerating cells of the Advanced Test Accelerator (ATA) are presented and techniques employed to dampen the resonances are briefly described. The main thrust of this work is the mathematical model of the cells used to treat the resonances analytically. Both azimuthally symmetric (TMsub(0n0)) modes and beam-breakup (TMsub(1n0) modes are treated. Agreement between measured values and those predicted by the model is good for the TM_{130} mode, which is the only mode observed to drive the beam-breakup instability in ATA. The values are consistent with observed beam behaviour in the accelerator. The analytic treatment predicts a shunt impedance of 60 Ω and a Q of 5 for the predominant Tmsub(0n0) mode. Analytic calculations indicate that the damping techniques resulted in Q values and interaction impedances that are near optimum for the geometry of the accelerating cells.

4304 Storage Rings

REFER ALSO TO CITATION(S) 6300

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 5762, 6280, 6294, 6307, 6311, 6653, 6684, 6685, 6767, 6784, 6786

6330 **(BNL—40431) A time resolving data acquisition system for multiple high-resolution position sensitive detectors.** Dimmler, D.G. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-871006—15). NTIS, PC A03. Order Number DE88002627/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

An advanced time resolving data collection system for use in neutron and x-ray spectrometry has been implemented and put into routine operation. The system collects data from high-resolution position-sensitive area detectors with a maximum cumulative rate of 10^6 events per second. The events are sorted, in realtime, into many time-slice arrays. A programmable timing control unit allows for a wide choice of time sequences time-slice array sizes. The shortest dwell time on a slice may be below 1 ms and the delay to switch between slices is zero.

6331 **(IAE—4339/2) Determination of neutrino oscillation parameters in experments of long distance from a reactor (prospects of investigations).** Borovoj, A.A.; Gavrilov, S.L.; Dobrynin, Yu.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700602/JAW.

Possibilities of searching neutrino oscillations in experiments at nuclear reactors within large distances (hundred metres) from a reactor-detector are considered. It is shown that the accuracy of estimation of the mass square difference of basic neutrino states can be improved several times in comparison with the results excited. A possible detector design is discussed. 19 p.; 4 figs.

6332 **(IAEA-RL—153) Use of rechargeable nickel-cadmium batteries for portable radiation monitors.** Zaman, M.Q. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories). Aug 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700612/JAW.

An effort was taken to assess the chargers available at the local market and the use of rechargeable batteries in the portable radiation monitors. This report is a very brief description of the study and observations. In order to have fair and justified conclusions regarding the use of Ni-Cd battery in portable instruments, many criterions have to be considered which takes very long observations under some specified conditions. This report is a combination of previous experimental results by scientists, data supplied by the manufacturers and short time observations in Seibersdorf Labo-

ratory. The report has three parts (a) comparison of the ordinary battery with the rechargeables (b) selection of a suitable charger and (c) probability of application of the Ni-Cd battery in portable dosimeters. 6 refs, 11 figs, 2 tabs.

6333 **(IFVE-OEA—86-16) Microcomputer and control modules on the base of the K1810 microprocessor set.** Govorun, V.N.; Ermolin, Yu.V.; Gorbunov, N.V. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Joint Inst. for Nuclear Research, Dubna, USSR). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700629/JAW.

A single board microcomputer worked out on the basis of K1810BM86 is described. The auxiliary controller and branch driver intended for this microcomputer are also described. Some linkase variants of the microcomputer board and different controller and branch driver boards in one module to create intellectual control units are presented. 8 refs.; 5 figs.; 4 suppls.

6334 **(IFVE-ONF—86-199) Transformer coupling of particle detector and preamplifier. 2. Damping with cold resistor.** Krasnokutskij, R.N.; Fedyakin, N.N.; Shuvalov, R.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700637/JAW.

The analytical expressions for the noise spectral density and the signal transfer function at the output of the cold resistor charge sensitive amplifier damping the transformer are obtained. Measurement results are in good agreement with calculations. 5 refs.; 4 figs.; 1 tab.

6335 **(IFVE-ONF—86-217) On the choice of a element low-noise preamplifier on bipolar transistors.** Krasnokutskij, R.N.; Kurchaninov, L.L.; Tikhonov, V.V.; Fedyakin, N.N.; Shuvalov, R.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700639/JAW.

The dependence of the preamplifier equivalent noise charge (ENC) on the detector capacitance, shaping time and collector current of the head transistor is presented. The measurement results are in a good agreement with calculations based on a simple noise model, so tedious ENC measurements may be replaced by a simple selection of transistors on distributed base resistance and current gain factor and unsophisticated calculations. Soviet KT382 - type transistors have the same noise performance as the best Japan transistors NE578 and NE021 and it is possible to use it as a head transistor for nuclear electronics applications. 11 refs.; 4 figs.

6336 **(IFVE-ONF/OEA—86-229) Hybrid low-noise preamplifier.** Ivochkin, V.G.; Krasnokutskij, R.N.; Kurchaninov, L.L.; Fedyakin, N.N.; Shuvalov, R.S.; Tikhonov, V.V. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Irkutskij Gosudarstvennyj Univ., USSR). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700643/JAW.

Submitted to the journal Instrum Exp. Tech. .

Schematic diagram and performance specification of a fast low-noise preamplifier are presented in this paper. The hybrid preamplifier is made according to a thin-filmed technology and is designed for signal recording of particle fast detectors of comparatively small capacitance (C/sub D/ $\leqq$ 500 nPHI) - such as semiconducting microstring detectors, photodiodes and phototransistors, wire chambers with a low amplification factor, high pressure gas ionization calorimeters, microchannel plates. The Equivalent Noise Charge (r.m.s.) has a value of 2500 e/sup -/ at zero capacitance and slopes 22 e/sup -//pF, 18 e/sup -//pF and 14.6 e/sup -//pF, respectively for shaping times 20, 50 and 100 ns. Four preamplifiers are assembled on the chip 16x25 mm/sup 2/. 6 refs.; 3 figs.

6337 **(ITEF—16(1986)) Remote control command driver.** Komarnitskij, N.A.; Lyulevich, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700674/JAW.

The procedure of proton irradiation of tumors localized in the orbital and chest region caused the necessity to develop on-line control system. A remote control command driver (RCCD) is functionally a specialized peripheral computer processor of the system of position programmed control. RCCD structure is made in the form of a module of the VECTOR standard. The values of supply voltage parameters of electric signals as well as data exchange logics correspond to the requirements of the CAMAC-VECTOR standards. The description of a RCCD unit as well as its functions is given. The algorithm of operation and a RCCD functional diagram are described. 5 refs.; 15 figs.; 3 tabs.

6338 **(ITEF—80(1986)) Primary processing of events in the experiment to search for the /sup 136/Xe double beta decay.** Artem'ev, V.A.; Brakhman, Eh.V.; Zel'dovich, O.Ya. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700681/JAW.

The dependence of the electron drift rapidity on the drift field for mixtures with different percentage content of CH/sub 4/ and Xe is measured to search for the binary β-decay of /sup 136/ Xe. The algorithm identifying tracks of different electrons realized by the EC-1010 computer is described. 3 refs.; 6 figs.

6339 **(JINR—R-6-86-675) Spectrometric characteristics of the e γ coincidence magnetic lens spectrometer for on-line experiments.** Abrosimov, V.N.; Krupa, Eh.; Morozov, V.A.; Tan'ska-Krupa, V.; Razov, V.M.; Khudajberdiev, Eh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700531/JAW.

The results of investigations carried out on spectrometric characteristics of the $e\gamma$ coincidence spectrometric designed on the basis of the magnetic lens spectrometer with a triangular shape of the magnetic field and aimed at operating in the proton beam of the JINR phasotron on-line with the mass-separator are presented. $\Delta B/$ sub rho//B/sub rho/ $\sim$ 0.4% momentum resolution with the source 1 mm in diameter and 0.6% relative aperture is achieved in the spectrometer. Time resolution - 410 ps with the slope of the instant coincidence curve - 50 ps and E/sub γ/ $>$ 900 keV at E/sub β/=250 keV using plastic scintillator in the γ-spectrometer with / sup 60/Co source is obtained. 4 refs.; 10 figs.

6340 **(JINR—R-10-86-597) Analysis of errors of electronic apparatus for position-sensitive neutron detector with a high-resistance anode. A device complex.** Novozhilov, V.E.; Tishin, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700533/JAW.

The effect of errors of electronic device operating with position-sensitive detector (PSD) on position spectra is analysed. The contribution of input preamplifier current noises and changes of the shape of detector signals into position resolution is considered. It is shown that by a corresponding choice of detector device parameters a position resolution could be achieved not worse that 5-7 mm on detector length up to 50 cm. Position spectrum errors due to ADC discreteness and nonlinearity are estimated. A complex of electronic devices for PSD including preamplifiers, spectroscopy, fast ADC, a digital processor for determining a position by value of two amplitude signals from PSD ends is described. 5 refs.; 6 figs.

6341 **(JINR—R-10-86-621) AUTOP-86 programme package for spectrometric data processing on SM computer.** Churakov, A.K.; Byalko, A.A.; Volkov, N.G.; Fominykh, M.I.; Ferentsej, J.; Tsupko-Sitnikov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700535/JAW.

A composition and capabilities of the AUTOP programme package for mini-computers are described. The package is intended for solving research and applied tasks related to processing spectrometric information. It consists of 19 programmes (including analysis of energy, time and NGR-spectra) and includes various aspects of processing and analysis of spectrometric data from smoothing, search for peaks and minimization of complex functionals by different methods, using several model functions, to gauging and display of graphic information. All programmes are written in FORTRAN-4, adapted for SM-3, SM-4 and Electronika-60 computers, and may operate in an interactive mode. The package also includes descriptions and instructions for users, checking data and reference results. 10 refs.; 11 figs.

6342 **(JINR—R-10-86-622) KATI and LIFT programs for spectrometric data processing on SM computer. Approximation by asymmetrical Gaussian superposition and convolution of exponent sum with instrumental function.** Churakov, A.K.; Tsupko-Sitnikov, V.M.; Fominykh, M.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700536/JAW.

Two programmes for the dialogue processing of spectrometric information of SM-type mini-computers are described. KATI is a programme for approximation of experimental data which can be presented by a superposition of asymmetric Gaussians (separation of components of fission fragments, analysis of gamma and X-ray spectra, α and β spectra). LIFT is a programme for analysis of time characteristics of processes under investigation (radioactive decay, fluorescent analysis, lifetimes of excited levels, etc.). The approximating function is a convolution of a Gaussian-like instrumental function with the sum of exponentials. The common feature for two programmes is the use of a special index algorithm for assignment of the approximating function. It allows binding or fixing parameters of different components. Thus, if there is preliminary information, one can avoid solution instability caused by absorption of smaller components by larger ones due to increase in asymmetry of larger components or difficulty in separation of close exponentials (LIFT). 2 refs.; 2 figs.

6343 **(JINR—R-10-86-666) Statistical approach in the problem of pattern recognition in high energy physics. Point model of track images.** Ioseliani, Ts.I.; Ososkov, G.A.; Chernov, N.I.; Shandrikova, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700538/JAW.

The problem of particle track recognition in two-dimensional data set of points obtained by an image digitalization is considered. For this problem a formal mathematical model of data is suggested. The shape of each track is supposed to be an arc of a circle or close to it. The number of tracks is to be found too. It is shown that maximum - likelihood estimation of parameters of all tracks simultaneously combined with dynamical cluster method solves this problem under zero-guidance conditions. The algorithm of recognition has been tested by the Monte Carlo data for a hydrogen bubble chamber. Its high efficiency is shown. 23 refs.; 4 figs.

6344 **(JINR—R-10-86-706) High-automated system of film data mathematical processing for polarized deuteron experiments.** Balgansuren, Ya.; Buzdavina, N.A.; Glagolev, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700539/JAW.

A specialized software system which allowed to reduce essentially the time of experimental data analysis has been developed in order to provide timely processing of film information in polarized deuteron experiments. With its help preliminary data on deuteron polarization has been obtained in a few months after experiment start up, and the total data processing (15 thousand events) has been carried out in less than in a year from the chamber irradiation time. High rate of data processing has been achieved due to complex automation of all stages of processing. 10 refs.; 1 fig.; 1 tab.

6345 **(JINR—R-10-86-712) Microprocessor emulating the intermediate code for FORTRAN compiler.** Frolikov, S.M.; Shumakov, M.N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700540/JAW.

Hardware and software for a fast FORTRAN microprocessor (FP) are described. Its machine language is an intermediate code of RT-II and RSX-II OS FORTRAN compiler. The time of execution of FORTRAN programs with 16-bit integer and 32-bit real numbers is by a factor of 12 better than that of SM-4 computer. Approximately 6-fold increase in speed of response is achieved due to faster hardware and the 2-fold is a consequence of more effective system architecture and instruction list. The processor is intended fro the use in data acquisition systems of high energy physics setups and could be used as a co-processor of SM-4, and Elektronika-60 type computers. 10 refs.; 1 fig.; 4 tabs.

6346 **(JINR—R-10-86-716) Multichannel scaling analyzer.** Zhuravlev, N.I.; Salamatin, A.V.; Sinaev, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700541/JAW.

An autonomous multichannel scaling analyzer is described. It consists of: scalers, multiplexer, memory controller for FIFO operation mode, 4Kx16 bit RAM, preset scalers, graphic display driver, controller for the link to a computer. The analyzer carrier out the following functions: the writing of data from the scalers to the FIFO memory cells with data adding to cell previous contents, output of the accumulated data to the graphic display, plotter or data-way. 6 refs.; 4 figs.

6347 **(JINR—R-10-86-723) Algorithm and program for recognition of compactly positioned vertices of events for the HPD minimum guidance system.** Shestakova, G.V.; Shigaev, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700542/JAW.

The ZONVER program algorithm for recognition of event vertices on track chamber photographs is described. The ZONVER program constructs a full set of vertex-type structures in film plane using filtered tracks as source data. The algorithm is suitable for using in automatic scanning and measuring systems for track chamber photograph analysis. 7 refs.; 1 fig.; 1 tab.

6348 **(JINR—R-10-86-773) Statistical approach to the problem of pattern recognition in high energy physics. Track reconstruction using compressed data.** Ososkov, G.A.; Chernov, N.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700543/JAW.

Solution of the problem for the case when the scanning data previously compressed into linear track elements (LTE) is considered. The set of LTF is to be clustered into M clusters corresponding to the tracks on the image (M is possibly unknown) leaving the rest of LTF in the noise cluster. A statistical model of the compressed data is suggested, which makes it possible to organize the recognition process by means of the dynamic clustering method intended to maximize the likelihood function. The main goal of the algorithm implementation is to accelerate calculations. The cluster reconstructing process is formalized and some tricks are applied to reduce considerably the data sorting and to speed the likelihood function calculations. As a result, the processing speed of 3-6 sec/frame has been obtained for real frame containing up to 300 arbitrary situated LTE having arbitrary lengths. 11 refs.; 3 figs.

6349 (JINR—R-10-86-776) Modular system for spectrometrical data acquisition. Input module. Boja, J.; Vagov, V.A.; Zhukov, G.P.; Rubin, D.; Harangozo, Zs. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700545/JAW.

An input module of a CAMAC data acquisition system is described. It is intended for experimental data receiving and buffering. The module provides data reception either in parallel codes or as pulse trains. For the data input and output a specialized high speed auxsiliary Data Acquisition Bus is used. The data output is possible through the CAMAC dataway too. The synchronised and collaborated operation of some input modules provides the data processing for multidimensional measurements. 2 refs.; 2 figs.

6350 (JINR—R-10-86-777) Modular system for spectrometric data acquisition. Intermediate memory. Boja, J.; Vagov, V.A.; Zhukov, G.P.; Rubin, D.; Harangozo, Zs. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700546/JAW.

A 256x24 bit high speed buffer memory of a CAMAC Data Acquisition System is described having a FIFO (first in first out) organisation. For the data input and output a specialised high speed auxialiary Data Acquisition Bus is used. Data output is possible throught the CAMAC Dataway too. 3 refs.; 4 figs.

6351 (JINR—R-10-86-786) Problems of organization of mass processes of simulation, acquisition and processing of experimental data at computers. Govorun, N.N.; Evsikov, I.I.; Ivanchenko, I.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700547/JAW.

Submitted to the journal Programmirovanie.

The approach, methods and programs of effective organization of mass processes for stimulations, acquisition and processing of experimental data at multiuser computers were considered. In the frames of this approach the efficient increase of reliability and productivity of mass processes for a wide range of alternations of operating surrounding characteristics is provided. The considered principles are illustrated on an example of data processing from the BIS-2 large-scale spectrometer, JINR. 10 refs.

6352 (JINR—R-10-86-797) Software hierarchical organization at experiment automation. Gyunter, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700548/JAW.

CAMAC microprocessor system with a heierarchical software organization is presented. The control functions are realized as commands of the dialoguage MCL. These commands are composed by software modules on 4 layers. Each layer represents a sphere of the experiment control of microcomputer. Each control process and device has its own software module. The structure of the process and the control equipment has its analogue in the modular software structure. The software is very flexible in relation to changes of hardware or control algorithms. The migration of process control algorithms from MCL language level into lower levels significantly improves timing characteristics of the system. In this experiment the system controls magnetic fields and the temperature of the cryostat, and monitors the state of experiment and equipment. 4 refs.; 5 figs.

6353 (JINR—R-10-86-804) Program summing up of the bubble chamber experiment. Balgansurehn, Ya.; Glagolev, V.V.; Zaikina, A.G.; Ivanov, V.G.; Pervushov, V.V.; Pestova, G.D.; Kacharava, A.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700549/JAW.

During the creation of a high-automated system for film data mathematical processing a rather simple and efficient system for maintaining the bookkeeping of "history" information has been developed. It permitted to automate practically completely the process of summing up the bubble chamber experiment. 8 refs.; 2 figs.; 1 tab.

6354 (JINR—R-10-86-805) Automated procedure for data summary tape forming in bubble chamber experiment. Balgansurehn, Ya.; Buzdavina, N.A.; Glagolev, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700550/JAW.

An automated procedure for data summary tape (DST) forming in bubble chamber experiment, results of application in two experiments and short write-up of software are described. Test of this procedure has shown that it reduced by several times manual work expenses for an event interpretation, but data copying and selection onto "DST" are provided almost without manual work. 8 refs.; 1 fig.

6355 (JINR—R-10-86-824) On KATOK program testing. Gadzhokov, V.; Brudanin, V.B.; Vasil'ev, S.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700551/JAW.

The modification of the well-known computer code for complex γ-ray spectra processing KATOK is described. The changes carried out allowed one to accelerate processing of spectra by more than twice without reducing solution quality. The test examples for comparing different versions of parogram and for making comparisons with other γ-ray processing codes are presented. 5 refs.; 1 fig.; 2 tabs.

6356 (JINR—R-13-86-815) Two-coordinate cylindrical chambers in self quenching streamer mode for the AYaKS vertex detector. Bilen'kij, M.S.; Kulinich, P.A.; Mitsel'makher, G.V.; Ol'shevskij, A.G.; Toledo, R.; Khazins, D.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700553/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The results on testing a system of four two-coordinate chambers operating in the self quenching streamer (SQS) mode are described. Each chamber is composed of a carrier cylinder of penopolyurethane and two flanges with anode and external cathode wires tightened between them. Another cathode is made of strips sputtered onto the cylinder surface. The chambers are tested with /sup 90/Sr β/sup -/-sourse and in a beam of the IHEP accelerator. Track efficiency is of >or approx. 96% and spatial resolution is ~ 0.35 mm, the loading being 10/sup 6/ particle/m/sup 2/ have been defined. 12 refs.; 10 figs.

6357 (JINR-R—1-86-185) Experimental investigation of high-resolution method fo particle detection in ultraviolet light. Ivanov, I.; Kuznetsov, V.A.; Maly, M.; Rusakov, V.A.; Samsonov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700707/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

Results of experimental study of a high-resolution method of track detection in ultraviolet light are described. Photographs of track imitation on the light and dark fields have been obtained with a resolution of (10-20) mkm. When the detector volume is illuminated with a pulsed nitrogen laser, the proposed method of track detection makes it possible to register reliably bubbles ~ 4 mkm in diameter in a precision hydrogen bubble chamber and to fix the production and decay of short-lived particles with a lifetime of ~ 10/sup -13/ s. 27 refs.; 10 figs.

6358 **(JINR-R—6-86-120) Beta particle identification by pulse shape in planar HPGe detectors.** Brudanin, V.B.; Sandukovskij, V.G.; Vylov, Ts.; Brianson, Sh.; Rukhadze, N.I. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Nuclear Problems; TsYaSMS, Orsay, France; Tbilisskij Gosudarstvennyj Univ., USSR). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700718/JAW.

Submitted to the 36. conference on nuclear spectroscopy and nuclear structure. Kharkov, Apr. 1986.

A possibility of particle separation in the planar HPGe detector is studied using the pulse rise time method. It is shown that the time selection of internal conversion electrons from continuous and discrete γ-radiation for /sup 207/Bi is equivalent to the background suppression of γ-quanta more than by a factor of 70 with insignificant loss of efficiency. The use of the pulse rise time method with a magnetic filter of the "Mini-orange" type provided an additional considerable increase in the β-spectrometer selectivity. 13 refs.; 6 figs.

6359 **(JINR-R—10-86-782) CAMAC crate intellectual controller.** Asmolov, A.G.; Semenov, A.A.; Sergeev, S.V.; Shpalek, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700725/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

The CAMAC crate intellectual controller, being the base of the data acquisition system designed for the HYPERON spectrometer is described. The modular controller is functionally and structurally divided into four parts: the crate dataway control module, the microcomputer module, the CAMAK dataway interface module, the immediate-access memory module. The microcomputer is made on the base of the KR1810VM86 microprocessor and equipped with 12 direct access channels. 13 refs.; 1 tab.

6360 **(KFKI—1987-26/G) Neutron spectrum measurement in the channel No. 182/5 of the KFKI WWR-SM reactor.** Vegh, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700727/JAW.

Foil irradiation experiments were performed at the water reflector of the WWR-SM research reactor of CRIP, Budapest. The irradiation position was channel No. 182/5, the experiments were carried out in order to investigate the effect of boron covers for the response regions of activation and fission detectors. In this paper foil materials, irardiation conditions, counting procedures and neutron spectrum adjustment calculations by the SAND-II program are documented. The possibility of using boron filters for neutron spectrum determination in a water moderator environment was confirmed by the results. 15 refs.; 7 figs.; 5 tables.

6361 **(KFKI—1987-29/G) Application of boron filters for neutron spectrum determination purposes in various neutron environments.** Vegh, J.; Zijp, W.L.; Nolthenius, H.J.; Alloggio, G.; Brega, E. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1987. 24p. (CONF-8705219—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700729/JAW.

From 6. ASTM-EURATOM symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

Foil irradiation experiments were performed at the graphite reflector of LFR (ECN, Petten) and at the water reflector of WWR-SM (CRIP, Budapest). In the experiments the effect of boron covers for the activation and fission detector response regions were investigated. The fluence rate perturbation effects introduced in the graphite or water environment by the applied B/sub 4/C-box were determined by means of transport calculations. Spectrum adjustment calculations were performed by the SAND-II and STAY'SL codes. The results showed that the applied B/sub 4/C cover shifted the response regions of the resonance reactions from the thermal region to the 0.1 keV - 1.0 MeV energy interval. If boron-covered reactions are included in a least squares spectrum adjustment procedure, the uncertainty of the solution spectrum is also reduced significantly in this energy region. 17 refs.; 6 figs.; 3 tables.

6362 **(KFKI—1987-34/A) Proton detection efficiency of a plastic scintillator telescope.** Fodor, Z.; Kovacs, Zs. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700730/JAW.

The efficiency function of a plastic scintillator telescope is calculated for protons up to 300 MeV by Monte Carlo method. The interaction of the protons with the nuclei of detectors was taken into account. The function depends on the particle kinetic energy and on the energy threshold of the detectors. The results of the calculation are tested experimentally. 5 refs.; 6 figs.

6363 **(KFTI—87-5) Multichannel electron counter with high space resolution.** Polishchuk, V.N.; Shevchenko, N.G.; Denyak, V.M.; Vladimirov, Yu.V.; Mazan'ko, B.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700564/JAW.

A multichannel scintillation counter of electrons with high space resolution δ=5.8 x 10/sup -4/ is developed to detect high-energy electrons at the output from the SP-95 magnetic spectrometer. A mechanism and control unit permitting to establish automatically detectors at the best focusing point according to the given parameters, and to use the best resolution of the spectrometer are developed. The counter is made on the base of PM-87 and PM-30 temporary photomultipliers. 1 ref.; 7 figs.

6364 **(LA-UR—87-3580) Comparison of existing and proposed HEP [High Energy Physics] data acquisition systems and their suitability for RHIC.** Sunier, J.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-870543—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001794/JAW.

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

In this note, a summary of data acquisition systems is presented for the High Energy Physics collider facilities. Particular emphasis is made on the data acquisition stages and trigger rates. The suitability of these systems for a relativistic heavy ion collider calorimeter detector with ports is then discussed. 6 refs., 8 figs., 1 tab. (LSP)

6365 **(MPI-PAE/Exp.El.—176) Optimum track fitting in the presence of multiple scattering.** Lutz, G. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Jun 1987. 26p. (CONF-870632—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750543/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

A method for track fitting is proposed which attempts to be as close as possible to the real track along the full path length. This is done by the introduction of scattering planes in which the particle is allowed to change its direction. A fit over the full track length includes the probability of direction change by scattering. Using matrix notation a fairly simple formalism for error estimation has been developed. Results of this method are compared to those of more widely used procedures for 'typical' examples of High Energy Spectrometers.

6366 **(MPI-PAE/Exp.El.—179) Multi event storage random access readout pixel detector.** Kemmer, J.; Lutz, G. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.)). Jul 1987. 8p. (CONF-870632—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750544/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

Since a few years semiconductor detectors (strip detectors and CCDs) have become appreciated tools for high precision particle tracking. Application in the high rate environment of future hadron colliders requires storage of several events until a trigger decision has been taken, as well as gating during readout. This is possible in principle for strip detectors, although with great and so far unsolved problems, by development of monolithic integrated electronics with multiple data storage capability. CCDs are extremely attractive devices because of their two dimensional measuring capability. Presently available or conceived CCDs seem to be excluded in principle however due to their slow readout speed and difficulty in gating. The proposed new detector-amplification device should allow storage of several successive events and selected non destructive readout of the information.

6367 **(N—87-27589) Normal incidence high resolution X-ray telescope for solar coronal observations. Semiannual progress report, 1 Feburary-31 July 1987.** Golub, L. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Aug 1987. 26p. (NASA-CR—181225; NAS—1.26:181225; SAPR—6). NTIS, PC A03/MF A01.

The preflight preparation of the multilayer mirror fabrication and testing, integration and testing, and WSMR activities are described. Post-flight analysis shows that all payload systems and subsystems performed well within acceptable limits, with the sole exception of the light-blocking prefilters. Suggested corrective actions were discussed. Refurbishment and reflight are then described.

6368 **(N—87-28403) Computer system to analyze showers in nuclear emulsions: Center Director's discretionary fund report. Final report.** Meegan, C.A.; Fountain, W.F.; Berry, F.A. Jr. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Aug 1987. 16p. (NASA-TM—100310; NAS—1.15:100310). NTIS, PC A02/MF A01.

A system to rapidly digitize data from showers in nuclear emulsions is described. A TV camera views the emulsions though a microscope. The TV output is superimposed on the monitor of a minicomputer. The operator uses the computer's graphics capability to mark the positions of particle tracks. The coordinates of each track are stored on a disk. The computer then predicts the coordinates of each track through successive layers of emulsion. The operator, guided by the predictions, thus tracks and stores the development of the shower. The system provides a significant improvement over purely manual methods of recording shower development in nuclear emulsion stacks.

6369 **(NEI-DK—47) Density measurement by means of once scattered gamma radiation the ETG probe, principles and equipment.** Joergensen, J.L.; Oelgaard, P.L.; Berg, F. (Danmarks Tekniske Hoejskole, Lyngby. Afdelingen for Elektrofysik). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750347/JAW.

National Road Laboratory, Note 200.; Also published in Danish as Note 198.

The Department of Electrophysics, the Technical University of Denmark, and the Danish National Road Laboratory have together developed a new patent claimed device for measurements of the in situ density of materials. This report describes the principles of the system and some experimental results. The system is based on the once scattered gamma radiation. In a totally non-destructive and fast way it is possible to measure the density of up to 25 cm thick layers. Furthermore, an estimate of the density variation through the layer may be obtained. Thus the gauge represents a new generation of equipment for e.g. compaction control of road constructions.

6370 **(PCCF-T—86-08) Dosimetry techniques applied to thermoluminescent age estimation.** Erramli, H. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Dec 1986. 174p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750631/JAW.

The reliability and the ease of the field application of the measuring techniques of natural radioactivity dosimetry are studied. The natural radioactivity in minerals in composed of the internal dose deposited by alpha and beta radiations issued from the sample itself and the external dose deposited by gamma and cosmic radiations issued from the surroundings of the sample. Two technics for external dosimetry are examined in details. TL Dosimetry and field gamma dosimetry. Calibration and experimental conditions are presented. A new integrated dosimetric method for internal and external dose measure is proposed: the TL dosimeter is placed in the soil in exactly the same conditions as the sample ones, during a time long enough for the total dose evaluation.

6371 **(PTB-Ra—19) Environmental radioactivity - problems in activity measurements.** Debertin, K.; Kolb, W.; Lauterbach, U.; Pessara, W. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Radioaktivitaet). Mar 1987. 77p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751033/JAW.

Laboratory methods for the measurement of radioactivity in environmental samples are considered to be well developed and established. After the Chernobyl accident, however, it became evident that not everywhere was one prepared for quick in-situ activity measurements and that many measurement results were questionable. We show the difficulties occurring in activity measurements with simple instruments to be used directly in the environment. In addition, several problems in gamma-ray spectrometry with environmental samples are discussed, problems which - if disregarded - may also lead to erroneous activity values in the case of laboratory measurements.

6372 **(RI—178) Use of pressed scintillation detectors in Moessbauer spectroscopy and in nuclear technology instrumentation.** Ekimov, S.P.; Krizhanskij, L.M. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700573/JAW.

The method of isostatic pressing allows thin ($\geq$0.1 mm) scintillation detectors on the base of NaI(Tl) with assigned thickness and high spectrometric parameters to be prepared. Considering an example of detection of /sup 57/Fe and /sup 125/Te Moessbauer radiation it has been shown that there is a detector optimal thickness providing maximum precision of measurement as a function of background radiation. The proposed estimation of detector optimal thickness is suitable for all cases of soft γ- or X radiation detection on the background of high-level photon radiation which occurs, for example, in γ-densitometry of radioactive solutions, X-ray spectrometry of radioactive samples etc. 5 refs.; 5 figs.

6373 **(SLAC-PUB—4432) Construction and initial operation of a proportional wire detector for use in a Cerenkov ring imaging system.** Va'Vra, J.; Bienz, T.; Bird, F.; Gaillard, M.; Hallewell, G.; Kwon, Y.J.; Leith, D.; Ratcliff, B.; Rensing, P.; Schultz, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); California Univ., Santa Cruz (USA); California Univ., Santa Barbara (USA); Cincinnati Univ., OH (USA); Rutgers--the State Univ., New Brunswick, NJ (USA)). Sep 1987. Contract AC03-76SF00515;AT03-76ER70023. 6p. (CONF-871006—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002566/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

We report on the final version of the multiwire single electron detector for the Cerenkov ring imaging device at SLD. We describe recent R and D effort to define the design parameters; we describe the details of the geometry of the detector, and experimental tests with the detector itself.

6374 **(SLAC-PUB—4434) Report of the large solenoid detector group.** Hanson, G.G.; Mori, S.; Pondrom, L.G.; Williams, H.H.; Barnett, B.; Barnes, V.; Cashmore, R.; Chiba, M.; DeSalvo, R.; Devlin, T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Tsukuba Univ., Sakura, Ibaraki (Japan). Inst. of Applied Physics; Wisconsin Univ., Madison (USA). Dept. of Physics; Pennsylvania Univ., Philadelphia (USA). Dept. of Physics; Johns Hopkins Univ., Baltimore, MD (USA); Purdue Univ., Lafayette, IN (USA)). Sep 1987. Contract AC03-76SF00515. 25p. (CONF-870739—5). NTIS, PC A02/MF A01. Order Number DE88002564/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

This report presents a conceptual design of a large solenoid for studying physics at the SSC. The parameters and nature of the detector have been chosen based on present estimates of what is required to allow the study of heavy quarks, supersymmetry, heavy Higgs particles, WW scattering at large invariant masses, new W and Z bosons, and very large momentum transfer parton-parton scattering. Simply stated, the goal is to obtain optimum detection and identification of electrons, muons, neutrinos, jets, W's and Z's over a large rapidity region. The primary region of interest extends over +-3 units of rapidity, although the calorimetry must extend to +-5.5 units if optimal missing energy resolution is to be obtained. A magnetic field was incorporated because of the importance of identifying the signs of the charges for both electrons and muons and because of the added possibility of identifying tau leptons and secondary vertices. In addition, the existence of a magnetic field may prove useful for studying new physics processes about which we currently have no knowledge. Since hermeticity of the calorimetry is extremely important, the entire central and endcap calorimeters were located inside the solenoid. This does not at the moment seem to produce significant problems (although many issues remain to be resolved) and in fact leads to a very effective muon detector in the central region.

6375 **Ion detector.** Tullis, A.M. (to Dept. of Energy, Washington, DC). US Patent 4,697,083. 29 Sep 1987. Filed date 30 Jan 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An improved ionization detective device is described comprising: an ionization chamber; a central electrode within the chamber; a cylindrical electrode member within the chamber; and a collet electrode member within the chamber; and a collet frictionally fitted around at least one of the electrodes. The collet has electrical contact means carried in a groove therein to contact a surface of at least one of the electrodes.

6376 **Scintillation light transport and detection.** Gabriel, T.A.; Lillie, R.A. (Oak Ridge National Lab., TN, USA). *Nuclear Instruments and Methods in Physics Research;* **258**: No. 2, 242-245(1 Aug 1987). Contract AC05-84OR21400.

Also published as report ORNL/TM—10047.

The MORSE neutron gamma-ray transport code has been modified to allow for the transport of scintillation light. This modified code is used to analyze the light collection characteristics of a large liquid scintillator module (18 x 18 x 350 cm/sup 3/).

6377 **Response functions for bismuth germanate detectors.** Wender, S.A.; Auchampaugh, G.F.; Hsu, H.; Debevec, P.T.; LeBrun, S.F.; Hoblit, S.D. (Los Alamos National Lab., NM, USA; Illinois Univ., Urbana, USA). *Nuclear Instruments and Methods in Physics Research;* **258**: No. 2, 225-229(1 Aug 1987).

A method of calculating the line shape and absolute efficiency of a 7.6 cm by 7.6 cm bismuth germanate scintillator for incident γ-rays between 6 and 40 MeV has been developed. The computer code 'CYLTRAN' was used to calculate the energy deposited in the crystal, and the output of the code was smeared with an empirically determined resolution function. The results of these calculations are compared to pulse height spectra measured using monoenergetic photons. This technique should be applicable to a wide range of experimental geometries and scintillator types.

6378 **Self-absorption corrections for gamma ray spectral measurements of /sup 210/Pb in environmental samples.** Miller, K.M. (USDOE Environmental Measurements Lab., New York). *Nuclear Instruments and Methods in Physics Research;* **258**: No. 2, 281-285(1 Aug 1987). (In English).

Theoretical considerations and experimental data are used to demonstrate the basic behaviour of the self-absorption effect of a sample matrix in gamma ray spectrometry, particularly as it relates to the analysis of /sup 210/Pb in environmental media. The results indicate that it may not be appropriate to apply the commonly used self-absorption function in all cases.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 6394

6379 **(SLAC-PUB—4462) Radiation damage studies of a custom-designed VLSI readout chip.** Dauncey, P.; Barnett, B.A.; Drewer, D.; Matthews, J.A.J.; Breakstone, A.; Parker, S.; Adolphsen, C.; Gratta, G.; Litke, A.; Jacobsen, R. (Johns Hopkins Univ., Baltimore, MD (USA); Hawaii Univ., Honolulu (USA); California Univ., Santa Cruz (USA). Inst. for Particle Physics; Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1987. Contract AC03-76SF00515;AA03-76SF00034;AC03-83ER40103. 6p. (CONF-871006—12; JHU-HEP—71016). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002557/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Two structurally similar versions of an NMOS custom VLSI circuit, manufactured at different foundries, have been irradiated with a ^{60}Co source up to doses of 100 krad. Large differences in their behaviour after irradiation have been seen which are thought to be due to the fabrication processes. These differences are observed in test structure measurements and overall chip performance. An increase in circuit noise causes one version of the chip to be unusable after radiation doses of 20 krad.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 5763, 6074, 6081, 6095, 6240, 6244, 7002

6380 **(DOE/ER/10635—6) The glow discharge as an atomization and ionization device: Progress report, May 1, 1985-August 31,. 1987.** Harrison, W.W. (Virginia Univ., Charlottesville (USA). Dept. of Chemistry). 1987. Contract AS05-80ER10635. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002129/JAW.

Brief summaries are given for the primary project, glow discharge mass spectroscopy (GDMS), and the spin-off projects, resonance ionization mass spectrometry and hollow cathode plume atomic emission and mass spectrometry. Major attention in glow discharge mass spectrometry centered on metals/alloys and powders requiring compaction. Glow discharge factors that affect or control the ion response of the samples were studied. Resonance ionization of the glow discharge was included to reduce or eliminate spectral interferences in GDMS. The hollow cathode plume was used in the analysis of metal alloys. (WRF)

6381 **(DOE/ER/45208—3) [Helium atom surface scattering apparatus for studies of crystalline surface dynamics]: Progress report covering the period from May 1, 1985 to April 30, 1988.** Safron, S.A.; Skofronick, J.G. (Florida State Univ., Tallahassee (USA)). [1987]. Contract FG05-85ER45208. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002104/JAW.

The primary goal of this grant was the construction of a state-of-the-art He atom-surface spectroscopy (HASS) scattering instrument which would be capable of determining both the structure and the dynamics of metal, insulator and semiconductor surfaces. The essence of the method is the measurement of the elastic and inelastic scattering of He atoms from the crystal surface as a func-

tion of angle and energy gains or losses. The time period for the construction was projected to be approximately three years, after which a program of studies on the surface dynamics of various crystal surfaces would be started. The project was begun on May 1, 1985, and this report covers the progress from inception to present. In what follows, we will show that the construction is very nearly complete, the nozzle beam has been characterized, both before and after scattering from a LiF crystal surface, and angular distributions from this surface have also been taken. They show, in addition to the specular and Bragg peaks, fine structure between the peaks due to various inelastic collision processes which have previously been reported in the literature. Our current efforts are to measure the inelastic processes by time-of-flight methods so as to repeat the previous surface dispersion measurements. 9 refs.

6382 (IFVE-OEIPK—86-41) Synchronization module for data acquisition in a computer. Datsko, N.A.; Ivanyushenkov, Yu.M.; Polyakov, B.F.; Kholodenko, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700634/JAW.

Control module of data acquisition in a computer (synchronizer) is described. The module realizes the shaping of signals of recording electronics detectors triggering according to the assigned set of physical triggers and according to data availability for the transmission to the computer and shapes inquiry signal for the computer service. The synchronizer module has 8 channel combined in 4 groups. The logic block-diagrams of the synchronizer channel groups are given. 1 ref.; 3 figs.

6383 (ITEF—7(1986)) Unit of unified control electronics for measuring projectors with visual centring. Kaspin, A.I.; Krupnov, V.E.; Sokolov, V.L.; Talinskij, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700672/JAW.

Multifunctional control electronics unit providing data acquisition, logic processing and information exchange detween measuring projectors with visual centring and on-line computer is described. A block diagram of the unit and basis circuits of separate functional units are given. Unit operation in different modes is described and time diagrams are given. 4 refs.; 13 figs.

6384 (JINR—R-10-86-660) Display-monitor with a special processor for control of image parameters in AELT-2/160 measuring system. Golyas, Yu.E.; Kunyaev, S.V.; Semejkin, A.Yu.; Kryukova, L.M.; Rubtsov, V.F.; Smirnov, V.N.; Shkundenkov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700537/JAW.

A new version of apparatus for control of display-monitor in AELT-2/160 measurement system on-line with the SM-4 computer is described. This version of apparatus for control of display-monitor consists of three CAMAC modules having the following features: new apparatus for control operates with full 16-bit point coordinates; it has possibility of entering the data into control module memory both from the computer and from measuring channel of control scheme of AELT-2/160; has a possibility of accomplishment of zone selecting, changing the size and image displacement. 2 refs.; 2 figs.

6385 (N—87-28022) Gas adsorption/absorption heat switch, phase 1. Final report. Chan, C.K. (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1987. 197p. (NASA-CR—181327; JPL-PUBL—87-7; NAS—1.26:181327). NTIS, PC A09/MF A01.

The service life and/or reliability of far-infrared sensors on surveillance satellites is presently limited by the cryocooler. The life and/or reliability, however, can be extended by using redundant cryocoolers. To reduce parasitic heat leak, each stage of the inactive redundant cryocooler must be thermally isolated from the optical system, while each stage of the active cryocooler must be thermally connected to the system. The thermal break or the thermal contact can be controlled by heat switches. Among different physical mechanisms for heat switching, mechanically activated heat switches tend to have low reliability and, furthermore, require a large contact force. Magnetoresistive heat switches are, except at very low temperatures, of very low efficiency. Heat switches operated by the heat pipe principle usually require a long response time. A sealed gas gap heat switch operated by an adsorption pump has no mechanical motion and should provide the reliability and long lifetime required in long-term space missions. Another potential application of a heat switch is the thermal isolation of the optical plane during decontamination.

6386 (NIIEFA-P-G—0712) Integrating converter with small output drift. Fedorishin, Yu.M. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700572/JAW.

Integrating analog-to-digital converter to control magnetic characteristics of superconducting magnetic systems is described. Possible use of two-step integration in low-level signal converters (few microvolt) with the integration period of few tens of seconds is considered. Integrating converter zero-level compensating circuit is suggested. 10 refs.; 4 figs.

6387 (SAND—87-1262) Accelerometer evaluation report. Martin, S.B.; Bennett, A.A. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 122p. NTIS, PC A06. Order Number DE88002372/JAW.

Silicon micromachined accelerometers, developed under contract to Sandia by Endevco and Honeywell, were tested and evaluated. A commercial accelerometer by Entran and the Sandia-designed Quartz Digital Accelerometer were also included in the evaluation program. The test results are presented in this report.

6388 (UCID—21217) Picosecond cable calibrator: Beam Research Program. Donnelly, D.S. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002375/JAW.

The Picosecond Cable Calibrator is an instrument which accurately measures the electrical length (delay) of coaxial cables with a resolution of one picosecond. Other major features of the calibrator are: high accuracy, wide dynamic range; low cost; measurement simplicity; small size; single-ended cable access; and memory-stored substract. This paper provides a detailed description of performance characteristics; operating instructions; theory of operation; and maintenance. (FI)

6389 (Y/DW—745) Measurement of surfactant concentrations in Freon-113 solutions by spinning-drop tensiometry. McLaughlin, J.F.; Harless, D.P. (Oak Ridge Y-12 Plant, TN (USA)). 24 Sep 1987. Contract AC05-84OS21400. 21p. (CONF-871015—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002241/JAW.

From 30. conference on analytical chemistry in energy technology; Knoxville, TN, USA (20 Oct 1987).

The spinning drop tensiometer has been used as a means of rapidly measuring the quantity of surfactant in Freon-113 solutions. The instrument was evaluated using known solutions of 50 to 2000 ppM surfactant in Freon. The results obtained showed this method of measurement to be sensitive to variations in the surfactant content, especially in the 50 to 300 ppM range. After the instrument had been demonstrated to be a viable means of monitoring the surfactant content of laboratory-prepared solutions, a series of experiments was carried out demonstrating that this instrument could be used to rapidly monitor the surfactant content of the Freon-surfactant solutions used in the uranium chip processing area of the Oak Ridge Y-12 Plant.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 6554

6390 **(AD-A—184368/9/XAB) Simulated nuclear multi-bursts conducted in a water tank. Technical report, 7 October 1983-30 January 1985.** Colbert, R.G.; Zimmerman, A.W. (TRW Electronics and Defense Sector, Redondo Beach, CA (USA)). 30 Jan 1985. 88p. NTIS, PC A05/MF A01.

Simultaneous multiple-cloud experiments were carried out in a water tank. Salt was used to achieve a linear density gradient in the tank to simulate the atmosphere. A nuclear fireball was simulated with a high-density bubble of saltwater dropped into the top of the tank. The bubble grew by turbulent entrainment as it fell into saltwater with an increasing density. The fall stops when the density inside the cloud reaches the density of its environment. Cloud dimensions were obtained for 5, 6, and 7 burst events. These cloud dimensions were compared with a model which is good fit to data from other multi-burst experiments. The model and the data from this program are in good agreement. These tests utilized existing hardware. Recommendations are made for a new facility which would be capable of simulating up to 70 bursts with an arbitrary time sequence. Instrumentation techniques to provide data other than cloud dimensions, e.g., velocity and density, are also recommended.

6391 **(PB—87-227864/XAB) Test of a prototype gate with fast opening equipping the shock tube 0 2.4-m at CEG). Technical note.** Gratias, S. (Direction des Recherches, Etudes et Techniques, Gramat (France). Centre d'Etudes de Gramat). Mar 1987. 28p. (In French). (NT/T—87-15). NTIS, PC E04/MF E04.

In nuclear-blast simulators at the Centre d'Etudes de Gramat, the generators are separated from the test section by diaphragms fitted with a pytotechnical device. Use of these diaphragms is not entirely satisfactory, so that it is contemplated to replace them by gates with fast opening. A prototype gate with 40-ms opening time was tested on the 2.40-m 0 shock tube. These tests have demonstrated that a shock wave with an overpressure less than 0.85 b could not be formed accurately except with opening times of much less than 40 ms. From the point of view of its mechanical concept, on the other hand, the principle of the gate seems satisfactory; thus, some improvements will be made on it towards obtaining opening times of less than 20 ms.

6392 **(UCID—21244) Ground shock profiles for an accidental explosion at the proposed Large Rocket Test Facility at Arnold Engineering Development Center.** Davis, B.C. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002652/JAW.

This study is an assessment of the ground shock in profile which may be generated in the event of an accidental explosion at the proposed Large Rocket Test Facility (LRTF) at Arnold Engineering Development Center (AEDC). The assessment is accomplished by using the results of a previous study by the author and by reviewing existing ground motion data at depth, for sites with similar geology to expected conditions at AEDC. Empirical relationships are developed from these data and the relationships are used to predict the ground motion in profile. As indicated above, the surface ground motion predictions were developed in a previous study by the author and rely upon an existing relationship (Lipner et al.) to predict surface velocity. Empirical relationships developed in the course of the previous study, predict surface acceleration and displacement. The empirical relationships developed in this study are used to predict acceleration, velocity, and displacement at depth. The ground motions are presented in table form and as profile plots. The results of this study and previous studies by the same author are intended to be used for evaluating the siting of the LRTF.

6393 **(UCRL—95288) Research on the synthesis of heterocyclic explosives.** Coon, C.L. (Lawrence Livermore National Lab., CA (USA)). 20 Aug 1986. Contract W-7405-ENG-48. 6p. (CONF-8610134—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87001360/JAW.

From American defense preparedness symposium; Long Beach, CA, USA (27 Oct 1986).

Research has been carried out on a number of heterocyclic ring systems to produce new explosives that are more energetic and more stable than HMX. Our main emphasis on this program is on the synthesis of bicyclo-HMX; and we have synthesized the dinitrodiacetyl precursor to this material. In addition, several partially nitrated, fused imidazolidine-oxazine, imidazolidine-triazipine, and imidazolidine-oxadiazipine ring systems were synthesized for the first time. Several of these materials are considerably more dense than their estimated values. 5 refs., 4 figs.

4502 Nuclear

REFER ALSO TO CITATION(S) 6584

6394 **(AD-A—184035/4/XAB) Fallout radiation effects on telecommunications networks: analysis methodology. Final report.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 3 Dec 1986. 96p. NTIS, PC A05/MF A01.

Fallout radiation is the residual radiation following a detonation of a nuclear weapon. Wind and other associated weather conditions spread the fallout radiation to locations away from ground zero, inevitably including locations occupied by NSEP telecommunications equipment. Almost all currently manufactured telecommunications equipment contain semiconductor devices, making them particularly susceptible to failure due to fallout radiation. Even at low dosage levels, the effects of fallout radiation on semiconductor devices can be quite severe. This report describes a comprehensive methodology for assessing the effects of fallout radiation on telecommunication networks. The development of this methodology provides the OMNCS with a tool for assessing radiation effects on the NSEP telecommunications capabilities. It also provides the OMNCS with insight into increasing the survivability reconstitutability and restorability of NSEP-related networks.

6395 **(AD-A—184203/8/XAB) Teleseismic wave-form modeling incorporating the effects of known three-dimensional structure beneath the Nevada Test Site. Final report, 4 February 1985-3 February 1987.** Cormier, V.F. (Massachusetts Inst. of Tech., Cambridge (USA). Earth Resources Lab.). 8 Jun 1987. 106p. NTIS, PC A06/MF A01.

The pattern of teleseismic amplitudes from underground nuclear tests has been found to have strong variations as a function of location within a test site. Forward modeling of body waves in known three-dimensional structures beneath seismic sources is used to investigate the effects of such structures on teleseismic amplitudes and to determine the structural resolution necessary to formulate amplitude corrections for variations in source site and recording networks. Three-dimensional structures having scale lengths of 20 to 50 km down to 100 km depth with several per cent fluctuation in P and S velocity are shown to produce a factor of three fluctuation in the amplitude of teleseismic body waves. The associated travel-time fluctuations introduced by the three-dimensional structures are weak, being on the order of several tenths of a second, and exhibit only a weak regional correlation with amplitude fluctuations. A known structure beneath Pahute Mesa, Nevada Test Site may be used to formulate amplitude corrections that may reduce the variance in a yield estimate by 25%. Magnitudes based on measurements of coda amplitudes or integrated energy flux in a time window following and including the direct P phase can reduce the fluctuations within observations by a seismic network, but will be only partially successful in reducing the effects of near-source structure.

6396 **(AD-A—184454/7/XAB) Similarity solution for perturbation of a strong blast wave with radiation diffusion in a stratified medium. Technical report, 12 February-31 December 1986.** McCartor, G.; Wortman, W.R. (Mission Research Corp., Santa Barbara, CA (USA)). 31 Dec 1986. 52p. (MRC-R—767). NTIS, PC A04/MF A01.

A similarity solution for the first-order perturbation of a nearly spherical strong blast wave generated by a point source in a mildly stratified medium is found. The hydrodynamic equations include a radiation diffusion approximation to radiation transport which is of such a character to allow both the unperturbed and perturbed solutions to exhibit a similarity form. The cylindrically symmetric solution provides the flow in both radial and polar directions. Implications for circulation in flow fields of low-altitude atmospheric explosions are drawn.

6397 **(EPRI-EL—4351-SR) The nuclear electromagnetic pulse and the electric power grid: A different perspective: Special report.** Rabinowitz, M. (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 114p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920070/JAW.

This report primarily considers the potential effects of a single high-altitude nuclear burst on the US power grid. It describes various types of electromagnetic pulses (EMP) from a nuclear explosion and provides a brief historical overview of EMP. A comparison is made between EMP and natural phenomena such as lightning and solar storms. This report concludes that EMP effects are exaggerated because of an unrealistic assumption of the pulse that can be seen by the power system. An upper limit of the electric field of the very fast, high-amplitude EMP is derived from first principles. The resulting values indicate that although electric fields approaching 50 kV/m might be obtained locally, the energy content is significantly lower than the commonly presented values, and the electric field decreases rapidly with distance. Additional calculations show that the ionization produced by a nuclear burst severely attenuates the EMP. These findings all indicate that EMP damage to the US power grid in equipment flashovers and line flashovers from a high-altitude nuclear bomb will be negligible, except for localized damage to some unshielded electronic control systems. Since it is difficult to make accurate calculations of the coupling of EMP into complex electronic systems, this report relies on the results of other studies which indicate the possibility of minimal damage. 42 refs., 23 figs., 6 tabs.

6398 **(NVO—313) Analysis of nuclear test TRINITY radiological and meteorological data.** Quinn, V.E. (National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office). Sep 1987. Contract AI08-76DP00351. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002371/JAW.

This report describes the Weather Service Nuclear Support Office (WSNSO) analyses of the radiological and meteorological data collected for the TRINITY nuclear test. Inconsistencies in the radiological data and their resolution are discussed. The methods of normalizing the radiological data to a standard time and estimating fallout-arrival times are presented. The meteorological situations on event day and the following day are described. Comparisons of the WSNSO fallout analyses with analyses performed in the 1940s are presented. The radiological data used to derive the WSNSO 1987 fallout patterns are tabulated in appendices.

6399 **(UCRL—53820) Maintaining the US stockpile of nuclear weapons during a Low-Threshold or Comprehensive Test Ban.** Kidder, R.E. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 35p. NTIS, PC A03. Order Number DE88002478/JAW.

We review here results of several classes of US nuclear weapons tests conducted withith the principal strengths and weaknesses of nuclear weapons themselves. It is found that a high degree of confidence in the reliability of the existing stockpile is justified, and that it is sufficiently robust to permit confidence in the reliability of remanufactured warheads in the absence of nuclear explosive proof-tests. We also review problems encountered with the 14 nuclear weapon designs since 1958 that have been frequently and prominently cited as evidence that a Low-Threshold Test Ban (LTTB) or a Comprehensive Test Ban (CTB) would preclude the possibility of maintaining a reliable stockpile. It is concluded that that experience has little if any relevance to the question of maintaining the reliability of the stockpile of nuclear weapons that exists in 1987. Further, we discuss actions necessary to assure the future availability of materials needed to remanufacture nuclear weapons in the existing stockpile and the reliability of repackaged nuclear weapons. It is recommended that the Department of Energy be encouraged to undertake the formulation and execution of a Readiness Program whose purpose is to ensure that the US is prepared to maintain the reliability of its stockpile of nuclear weapons in the absence of nuclear explosive tests, and that funds earmarked for this purpose be provided.

6400 **(UCRL—53822) Report to Congress on stockpile reliability, weapon remanufacture and the role of nuclear testing.** Miller, G.H.; Brown, P.S.; Alonso, C.T. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 60p. NTIS, PC A04/MF A01. Order Number DE88002479/JAW.

This report analyzes two issues: (1) "whether past warhead reliability problems demonstrate that nuclear explosive testing is needed to identify or to correct stockpile reliability," or (2) "whether a program of stockpile inspection, nonnuclear testing, and remanufacture would be sufficient to deal with stockpile reliability problems." Chapter 1 examines the reasons for nuclear testing. Although the thrust of the request from Congressman Aspin et al., has to do with the need for nuclear testing as it relates to stockpile reliability and remanufacture, there are other very important reasons for nuclear testing. Since there has been increasing interest in the US Congress for more restrictive nuclear test limits, we have addressed the overall need for nuclear testing and the potential impact of further nuclear test limitations. Chapter 1 also summarizes the major conclusions of a recent study conducted by the Scientific and Academic Advisory Committee (SAAC) for the President of the University of California; the SAAC report is entitled, "Nuclear Weapon Tests: The Role of the University of California-Department of Energy Laboratories." Chapter 2 presents a brief history of stockpile problems that involved post-deployment nuclear testing for their resolution. Chapter 3 addresses the problems involved in remanufacturing nuclear weapons, and Chapter 4 discusses measures that should be taken to prepare for possible future restrictive test limits.

6401 **(UCRL—96597) Atmospheric and climatic consequences of a major nuclear war: Results of recent research.** Golitsyn, G.S.; MacCracken, M.C. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 28p. (CONF-8703192—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000967/JAW.

From 8. session of the world climate research programme; Castelvecchio, Italy (23 Mar 1987).

During the last several years, comprehensive three-dimensional atmospheric circulation models, including detailed parametric formulations of a wide range of climatologically significant processes, have been applied to study the potential consequences of a major nuclear war involving the injection of smoke which could result from the large-scale fires ignited by such an exchange. For plausible smoke injections during the warm season of the year, all model calculations suggest that a significant climatic perturbation would result. In the lower range of smoke injection scenarios (producing of order 10 Tg of highly carbonaceous smoke), smoke would act primarily to inhibit convection and rainfall, especially over land areas, including possibly some disruption of the summer monsoon. The upper range of smoke scenarios (of order 100 Tg of highly carbonaceous smoke) would cause not only rapid and sharp decreases in land temperature and precipitation (a mid-latitude average land-temperature drop of the order of 20°C, up to perhaps twice this amount in continental interiors), but also seems likely to leave enough smoke in the atmosphere to persist into the following warm season, inducing a cooling of several degrees.

4503 Explosion Detection

6402 (AD-A—184450/5/XAB) Multichannel deconvolution of p waves at seismic arrays and three-component stations. Annual report, 1 October 1985-1 October 1986. Der, Z.A.; Lees, A.C.; Shumway, R.H.; McElfresh, T.W.; Marshall, M.E. (Teledyne Geotech, Alexandria, VA (USA). Alexandria Labs.). 30 Oct 1986. 116p. (TGAL—86-6). NTIS, PC A06/MF A01.

The results of a new multichannel method, applied to array recordings and three-component station networks for teleseismic P waves, are presented and interpreted in terms of possible surface reflections and other arrivals from the Nevada Test Site (NTS), Novaya Zemlya, and Eastern Kazakh Test Site (EKTS) nuclear explosions. The deconvolution method utilizes the well known fact that P-wave spectra can be decomposed into source and receiver spectral factors. The source functions obtained in the deconvolution process provide a better picture of the nature of explosion source time functions and, in particular, of the presence or lack of secondary arrivals following the P wave such as pP or spall. The presence of such secondary arrivals and their effects on the first cycle of the P wave are very important in yield estimation. For most events at the eastern part of EKTS the source time functions appear to contain a pP arrival but they also show later, unexplained arrivals and other complexities. At other test sites often there are no clearly identifiable pP phases in the deconvolved traces. Joint deconvolution of central EKTS data using all AWRE arrays indicated strong azimuthal asymmetries in the body-wave radiation. Deconvolutions of NTS events were considerably degraded by the limited signal bandwidth due to strong mantle attenuation under this test site. The site functions are also complex in most cases. Site and source effects contribute about equally to the energy observed in the P codas of the events analyzed.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 5574

6403 (DOE/ER/60314—3) Research project on CO_2-induced climate change. Cess, R.D.; Hameed, S. (State Univ. of New York, Albany (USA). Research Foundation). Nov 1987. Contract FG02-85ER60314. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002352/JAW.

The report presents summaries of progress in the following areas: (1) narrow and broad band measurements of the planetary albedo: conversion simulations with a general circulation model; (2) exploratory studies of cloud radiative forcing with a general circulation model; (3) diurnal variability of the planetary albedo; and (4) atmospheric climate feedback processes compared within general circulation models. (ACR)

6404 (DOE/EV/10539—6) Objective prediction of monthly mean surface temperature and climatological relationships to mid-tropospheric heights: Final report for the period November 1, 1980-October 31, 1986. Baer, F.; Klein, W. (Maryland Univ., College Park (USA). Dept. of Meteorology). May 1987. Contract AS05-81EV10539. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000908/JAW.

This report describes the derivation, testing, and characteristics of multiple regression equations for specifying monthly mean surface temperature in extra-tropical portions of North America and Eurasia from concurrent fields of mean 700 mb height over most of the northern hemisphere, plus the previous month's local temperature. The geographical distribution and seasonality of the specification equations and of temperature persistence are discussed, and the synoptic climatology of surface temperature in relation to the 700 mb circulation is derived. Experiments aimed at refining the existing specification equations are described. Two methods appear promising: use of heights at the 500 mb level, instead of 700 mb, and screening the entire network of previous surface temperatures, instead of only the local value, as potential predictors. Attempts to develop an objective method for predicting, rather than specifying, monthly mean temperatures are discussed. Almost 10% of the temperature variance in the United States during the winter months can be explained by the previous month's field of 700 mb height, surface temperature and snow cover. This result could probably be improved by using output of medium-range numerical models for 1 to 30 days in advance, properly weighted by their accuracy.

6405 (PNL—6279-Vol.6) Hanford Meteorological Station computer codes: Volume 6, The SFC computer code. Andrews, G.L.; Buck, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002556/JAW.

Each hour the Hanford Meteorological Station (HMS), operated by Pacific Northwest Laboratory, records and archives weather observations. Hourly surface weather observations consist of weather phenomena such as cloud type and coverage; dry bulb, wet bulb, and dew point temperatures; relative humidity; atmospheric pressure; and wind speed and direction. The SFC computer code is used to archive those weather observations and apply quality assurance checks to the data. This code accesses an input file, which contains the previous archive's date and hour and an output file, which contains surface observations for the current day. As part of the program, a data entry form consisting of 24 fields must be filled in. The information on the form is appended to the daily file, which provides an archive for the hourly surface observations.

6406 (PNL-SA—13326) A subsynoptic environment associated with two intermountain severe thunderstorm events. Schwartz, M.N.; Andrews, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1985. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000551/JAW.

Severe thunderstorms in the basin and plateau regions of the western US can have a significant influence on the economy and population of the area. In general, thunderstorms in the intermountain region (i.e., the region between the Cascade Range and Rocky Mountains) are associated with two processes: (1) orographic effects and (2) dynamic features. We investigated two severe thunderstorm events that affected the Columbia Basin during the evenings of 23 April and 30 April 1981. These events were associated with similar synoptic patterns and appeared to exhibit the same characteristics throughout their life histories. The purpose of this paper is to (1) bring attention to severe thunderstorms in the intermountain region, (2) identify possible mechanisms and processes associated with the 23 April and 30 April thunderstorm events, and (3) aid forecasters in recognizing synoptic and subsynoptic features that may initiate and maintain convection in this region. 13 refs., 12 figs.

6407 (PNL-SA—14947) Wind and temperature structure on the slopes of a mountain valley. Doran, J.C.; Horst, T.W.; Whiteman, C.D. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 5p. (CONF-870864—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000080/JAW.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

Wind and temperature measurements were made in a small valley in southeastern Washington. These measurements focused on the influence of the ambient valley wind and temperature structure on the development and structure of the winds and temperatures on the valley sidewalls. The effect of the sidewall slope flows on the development of the valley winds and temperatures is a considerably more difficult problem, because it involves the integrated result of many different influences, including the ambient synoptic conditions, the up- and down-valley topography, and so forth. In this paper we describe our measurements and present some preliminary observations and analyses. 4 refs., 7 figs.

6408 **(SAND—87-2571C) Lightning spectra in the near infrared.** Weidman, C.D.; Boye, A.; Crowell, L. (Arizona Univ., Tucson (USA). Inst. of Atmospheric Physics; Sandia National Labs., Albuquerque, NM (USA); Analytic Decisions, Inc., Albuquerque, NM (USA)). 28 Sep 1987. Contract AC04-76DP00789. 34p. (CONF-871219—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002218/JAW.

From American Geophysical Union fall meeting; San Francisco, CA, USA (6 Dec 1987).

Time resolved measurements of the spectra of rocket-triggered and natural lightning in the 0.85 to 1.4 μm wavelength interval were made during the summers of 1986 and 1987, in Florida, using a slitless spectrometer and a lead sulfide (PbS) vidicon detector with approximately 200 ms time resolution. The emissions from triggered discharges first became visible during the initial, continuing current portion of the discharge, tens to hundreds of milliseconds before the first return stroke. The brightest lines were observed above the triggering wire at 0.87 μm, a neutral atomic nitrogen NI multiplet, and in the upper one-half to one-third of the wire at 1.10, 1.17, 1.18, 1.24 and 1.25 μm. The latter emissions were neutral potassium multiplets. The NI multiplet at 0.87 μm has previously been observed in natural lightning; three new emissions at 1.01 (brightest), 1.05, and 1.25 μm (least bright) were found later in the discharges, both in and above the wire portion of the channel. The NI emissions were often very bright in discharges with only very low peak current amplitude return strokes, which suggests that the intensity of the near ir emissions may be affected more by the intensity and duration of the continuing current or the total charge transfer than by the peak impulse current. The four NI multiplets were the most prominent features in natural lightning spectra. Lightning continuum emissions are clearly visible on some of the brighter spectra and, because the ir spectra were recorded at a range of 2.2 km from the triggered discharges, some of the spectral features seem to have been attenuated by atmospheric absorption. 14 refs., 14 figs., 2 tabs.

6409 **(UCRL—96580) Three dimensional display of meteorological scientific data.** Grotch, S.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 6p. (CONF-8710161—1). NTIS, PC A02. Order Number DE88000776/JAW.

From Digital image processing and visual communications technologies in meteorology conference; Cambridge, MA, USA (26 Oct 1987).

Three dimensional plotting can be used effectively to spatially represent data in ways which can greatly enhance understanding. Such presentations are not yet widely used in routine data analysis. However, to effectively utilize 3D graphics a number of features should be available to the user. 3 refs., 9 figs.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5376, 5391, 5396, 5684, 5692, 5702, 5863, 5866, 5959, 5971, 5972, 5973, 5978, 6401, 6438, 6451, 6560

6410 **(AD-A—184324/2/XAB) Sampling airborne microorganisms. Summary report, 1 October 1985-30 September 1986.** Chatigny, M.A. (Naval Biosciences Lab., Oakland, CA (USA)). Sep 1986. 17p. (UC-NBL—978). NTIS, PC A02/MF A01.

Pub. in Occupational Disease, 83-87(Sep 1986).

In response to a rapidly increasing awarness of problems in air pollution and air hygiene, considerable emphasis has been placed on sampling of gaseous and particulate contaminants. Although included in the latter category, airborne microbes have not been considered major air pollutants as have chemical aerosols. They have been of some concern in extramural environments (plant diseases) and of considerable interest in intramural (hospital surgical theaters) environments. The intrinsic characteristics of microbes make them difficult to collect and assay quantitatively. The collection instrumentation available tends to be less sophisticated, though no less diverse, than that for other particulates and to require more processing after collection.

6411 **(AD-A—184373/9/XAB) Sampling microbial aerosols. Summary report, 1 October 1985-30 September 1986.** Chatigny, M.A. (Naval Biosciences Lab., Oakland, CA (USA)). Sep 1986. 8p. (UC-NBL—977). NTIS, PC A02/MF A01.

Pub. in Occupational Respiratory Diseases, 83-87(Sep 1986).

Collecting microbial aerosols is not substantially different from collecting any other airborne particulates. After collection, however, the processing of the sample is all important. These particles have life and the capacity to grow, multiply, and as parasites - cause undesirable effects in the multiplicity of hosts. No chemical or physical measurement(s) available today can assess all these characteristics. Even detection of their presence often requires the bio-amplification provided by the growth characteristics. Both indoor and outdoor air are seas of microbial particles. Depending on local conditions, concentrations of viable particles will range from a few per ft. to many thousands or even millions. Particles are nearly indistinguishable so that detecting a specific viable and infective type is a little like selecting a specific raindrop in a rainstorm. Only by careful choice of growth and assay procedures, can the microbes of interest be selected out of the collectate.

6412 **(CONF-8609248—2) Overview of trends and problems in indoor air quality.** Gammage, R.B. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014939/JAW.

From Georgia technical symposium on indoor air quality; Atlanta, GA, USA (23 Sep 1986).

This overview covers some historical perspectives of indoor air quality, the importance of perception and reality in some of the adverse human health effects, and standards and guidelines. Some possible reasons for the difficulties in identifying causative agents are considered. 2 figs.

6413 **(EGG-M—39086) Integrated Global Background Monitoring Network.** Wiersma, G.B.; Franklin, J.F.; Kohler, A.; Croze, H.; Boelcke, C. (EG and G Idaho, Inc., Idaho Falls (USA); Forest Service, Corvallis, OR (USA). Forestry Sciences Lab.; World Meteorological Organization, Geneva (Switzerland); United Nations Environment Program, Nairobi (Kenya)). Dec 1986. Contract AC07-76ID01570. 31p. (CONF-861269—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001503/JAW.

From 5. US-USSR symposium on comprehensive analysis of the environment; Washington, DC, USA (10 Dec 1986).

One of the more significant problems when trying to determine what impact is having on global cycles is not knowing what "natural" levels should be for both abiotic (gases, trace elements) and biotic (ecosystem functions) processes. The authors believe that a well designed, coordinated network of baseline stations in remote areas around the world can provide a data base will allow best current estimates to be made of biotic and abiotic baseline conditions. These baseline conditions will then help us make better comparisons with more impacted areas, and thus help us more fully understand the impact man is having on his world. This paper examines the history of background pollution monitoring at the international level, describes current activities in the field of "integrated" background monitoring, and proposes criteria for the development of a global network of baseline stations to coordinate background monitoring for the presence, accumulation and behavior of pollutants in remote ecosystems. In this paper, this network is called the Integrated Global Background Monitoring Network.

6414 **(IVA—276) Air pollution - a threat against Swedish forestry?.** (Royal Swedish Academy of Sciences, Stockholm). 1984. 227p. (In Swedish). (CONF-8406366—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750418/JAW.

From Symposium on air pollution and its effects on forests; Stockholm, Sweden (4 Jun 1984).

The key-note address was given by Dr. Robert M. White, President of the National Academy of Engineering (NAE), in the United States. He focused on the question: How and when can politicians make decisions based on limited data. Dr. Gunnar Abrahamsen from Norway lectured on the ecological effects of air pol-

lution in Europe. Immissions and emissions in Europe, air pollution effects on forests, and physiology and biochemistry effects on trees were highlighted by Swedish scientists The specific impact on forests and Swedish forestry was dealt with on the second day of the symposium by forestry people, whereby the varying effects of pollutants on coniferous and deciduous trees, the use of soil preparation and fertilizers were special highlights. Possible consequences for Scandinavia of increased timber cutting in Europe were discussed in detail. The two Academies decided to pass a resolution concerning the grave condition prevailing in European forests due to air pollution. This resolution has been distributed throughout Europe to corresponding academies and other learned societies. (authors).

6415 **(MISU-CM—64) Sulfate in precipitation. A presentation of data from the European air chemistry network.** Rodhe, H.; Granat, L.; Soederlund, R. (Stockholm Univ. (Sweden). Dept. of Meteorology). 9 Jan 1984. 77p. NTIS (US Sales Only), PC A05. Order Number DE88750398/JAW.

Data are presented on concentration of sulfate in precipitation obtained at more than 150 stations in northern Europe during the period 1955 to 1979. Sampling has been carried out on a monthly basis using bulk precipitation collectors. The quality of the data is discussed and brief remarks are made concerning areal variability, seasonal cycles and long-term changes. (authors).

6416 **(N—87-27334) Development of data processing, interpretation and analysis system for the remote sensing of trace atmospheric gas species. Final report, 22 January 1982-15 January 1986.** Casas, J.C.; Saylor, M.S.; Kindle, E.C. (Old Dominion Univ., Norfolk, VA (USA)). Apr 1987. 39p. (NASA-CR—180619; NAS—1.26:180619; GSTR—87-1). NTIS, PC A03/MF A01.

The major emphasis is on the advancement of remote sensing technology. In particular, the gas filter correlation radiometer (GFCR) technique was applied to the measurement of trace gas species, such as carbon monoxide (CO), from airborne and Earth orbiting platforms. Through a series of low altitude aircraft flights, high altitude aircraft flights, and orbiting space platform flights, data were collected and analyzed, culminating in the first global map of carbon monoxide concentration in the middle troposphere and stratosphere. The four major areas of this remote sensing program, known as the Measurement of Air Pollution from Satellites (MAPS) experiment, are: (1) data acquisition, (2) data processing, analysis, and interpretation algorithms, (3) data display techniques, and (4) information processing.

6417 **(NEI-DK—48) Dioxin emissions from straw-burning furnaces. Preliminary analysis.** Nielsen, P.R.; Wood Pedersen, J. (DK-Teknik, Soeborg (Denmark); Jysk Teknologisk, Aarhus (Denmark)). Sep 1987. 29p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750384/JAW.

The aim of this analysis was to find out if dioxins are emitted from a modern straw-fueled heating plant and from a socalled farm furnace and if so to determine the amount of emitted dioxins per m/sup 3/ flue gas and per ton straw. For both plants the content of chlorine in the straw was about 0,4%. The result of the measurements are: from the heating plant the avarage amount of dioxin was 0,016 nanogrammes/m/sup 3/ flue gas, which is equivalent to 100 ng/ton straw; from the furnace the average amount of dioxin was 1,7 ng/m/sup 3/ flue gas which is equivalent to 11.000 ng/ton straw. (LN).

6418 **(ORNL/CDIAC—21) Graduate student theses supported by Carbon Dioxide Research Division, Office of Basic Energy Sciences, US Department of Energy.** Millemann, R.E. (Oak Ridge National Lab., TN (USA). Carbon Dioxide Information Analysis Center). Sep 1987. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001484/JAW.

The US Department of Energy's Carbon Dioxide Research Division (CDRD) has a strong commitment to support graduate education. The purpose of this report was to summarize information on thesis research supported by CDRD and to make it available to carbon dioxide researchers and other interested persons. To date, 25 Ph.D. and 23 Master's theses, including 4 internship reports for the M.En. degree from Miami University, have been written based on research supported in whole or in part by CDRD funds. Of these, 16 are in the Carbon Cycle area, 11 relate to Climate, 17 to Vegetation Response, 3 to Sea Level, and 4 pertain to the Carbon Dioxide Information and Analysis Center with a few theses relevant to more than one area. The following four lists appear in this report: An Author List with the complete thesis citation, names of the major professor, major department, and contractor, and contract number. A Contractor List with the affiliation of each contractor and the thesis research supported by that contractor. A Program Area List with the theses grouped by subject area. Finally, a University List with the theses grouped by the degree-granting institutions.

6419 **(ORNL/Sub—86-22033/1-V1) Impacts of world development on selected characteristics of the atmosphere: An integrative approach: Volume 1, Main report.** Darmstadter, J.; Ayres, L.W.; Ayres, R.U.; Clark, W.C.; Crosson, P.; Crutzen, P.J.; Graedel, T.E.; McGill, R.; Richards, J.F.; Tarr, J.A. (Resources for the Future, Inc., Washington, DC (USA)). Sep 1987. Contract AC05-84OR21400. 164p. NTIS, PC A08/MF A01. Order Number DE88001495/JAW.

This study presents estimates and analyses on atmospheric emissions associated with regional and global development and on environmental impacts caused by such emissions. The developmental activities covered are energy production and combustion, industrial processes, and agricultural practices. Some attention is directed as well to emissions resulting from natural processes, as distinct from those governed by human activity. The impacts studied on a regional basis are photochemical smog, precipitation acidity, and atmospheric corrosion. The global issue addressed is stratospheric ozone modification. The regions included are northeastern US, Europe, and the Gangetic Plain of India. In addition, some consideration is given to the Amazonian Basin of Brazil. While the major part of the effort is directed to historical trends, illustrative 50- and 100-year projections are also presented. These point up the prospects of severe degradation in atmospheric quality resulting from emissions from a number of the developmental activities studied. These findings are presented more in qualitative than quantitative terms. Improvements in scientific understanding, data, and policy approaches are essential elements in conducting more refined research on these questions. 137 refs., 26 figs., 18 tabs.

6420 **(ORNL/Sub—86-22033/1-V2) Impacts of world development on selected characteristics of the atmosphere: An integrative approach: Volume 2, Appendices.** Darmstadter, J.; Ayres, L.W.; Ayres, R.U.; Clark, W.C.; Crosson, P.; Crutzen, P.J.; Graedel, T.E.; McGill, R.; Richards, J.F.; Tarr, J.A. (Resources for the Future, Inc., Washington, DC (USA). Renewable Resources Div.). Aug 1987. Contract AC05-84OR21400. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001496/JAW.

The following topics are addressed in this report: historical reconstruction of major atmospheric gaseous emissions in the US from 1880 to 1980; database and annotation; selected tables on methane, biomass and chlorofluorocarbons; and a statistical supplement to the historical reconstruction. 76 refs., 20 figs., 47 tabs.

6421 **(PB—87-220596/XAB) BACT/LAER (best available control technology/lowest achievable emission rate) Clearinghouse: a compilation of control technology determinations. Second supplement to 1985 edition. Summary tables and appendices A-H. Final report.** Dunbar, D.; Sorrell, C. (PEI Associates, Inc., Cincinnati, OH (USA)). Jun 1987. 342p. NTIS, PC A15/MF A01.

See also PB—86-226974.

This report explains the history of the BACT/LAER Clearinghouse, the background of the report format development, and acknowledges the continued support and effort of STAPPA and ALAPCO members. The report contains three summary tables consisting of: a list of new control-technology determinations received since May 1986, a list of all control-technology determinations that have been submitted, and a list of control-technology determinations for external combustion sources (boilers). A detailed listing of

source-type codes and abbreviations for process and emission limits are also shown. The report contains the detailed source listings for the determinations submitted in source type code 1.0 through source type code 12.0. The detailed source listing normally contains the following information: source type and size; company name and location; whether determination was BACT or LAER for new or modified source; the person, agency, and phone number that made the determination; permit issue date; estimated date of start-up; processes subject to the permit; through-put capacity; pollutant(s) emitted; emission limits; control equipment or process modification; a section for notes; and review status dates.

6422 **(PB—87-224697/XAB) Evaluation of the National Trends Network's site-placement design.** Seilkop, S.K. (Program Resources, Inc., Research Triangle Park, NC (USA)). Jun 1987. 125p. NTIS, PC A06/MF A01.

The National Acid Deposition Network/National Trends Network (NADP/NTN) consists of 200-wet deposition monitoring stations in the United States. Sufficient data have been collected to enable statistical analyses to be performed to determine if the site placement and numbers of sites are adequate to estimate temporal and spatial trends. Analysis of data from existing sites, assuming some sites were not present, and assuming additional sites were present were performed. Results showed that addition of new sites would not significantly increase the accuracy of concentration isopleths.

6423 **(PB—87-227278/XAB) Development of computer modules of particulate processes for regional particulate model.** Hudischewskyj, A.B.; Saxena, P.; Seigneur, C. (Systems Applications, Inc., San Rafael, CA (USA)). Jun 1987. 270p. NTIS, PC A12/MF A01.

The development of an aerosol model for inclusion in the EPA Regional Particulate Model is described. Existing computer modules of particulate processes developed under EPA contract are compared to determine efficient and accurate methods of simulating particulate behavior. These methods are incorporated into an aerosol model, which is accurate and efficient in its treatment of the dynamics, thermodynamics, and chemical composition of atmospheric aerosols. Evaluation of the aerosol model is described using simulations for a regional environment and an urban plume. The model performs well under a variety of atmospheric and meteorological conditions. The results indicate the aerosol model is a useful tool for PM-10 and visibility studies.

6424 **(PB—87-227351/XAB) Novel vapor-deposited lubricants for metal-forming processes. Final report, April 1985-December 1986.** Mills, J.J. (Forging Industry Education and Research Foundation, Cleveland, OH (USA)). Aug 1987. 39p. NTIS, PC A03/MF A01.

The report gives results of a preliminary laboratory study of the feasibility of using vapor-phase lubrication to lubricate industrial metal-forging dies. (NOTE: the forging and shaping of metal parts is one of many metal-fabricating processes that may generate volatile organic compounds and hydrocarbons. In typical metal-forming operations, hot metal is squeezed in lubricated dies to produce metal shapes in the form of the die cavity.) The report gives results of six tasks conducted during the study and discusses the potential production and environmental impact of the process. A vapor-lubrication system developed for general industrial use could significantly reduce the volume of forging lubricants required by present industrial-forging operations. The laboratory results indicate that it may be possible to reduce potential air-pollution emissions from forging using vapor lubrication by as much as 85%. This would be accomplished by using 85% less lubricant volume during metal forging.

6425 **(PB—87-227641/XAB) Western Conifers Research Cooperative 1987 research plan.** Olson, R.K. (Northrop Services, Inc., Corvallis, OR (USA)). Aug 1987. 94p. NTIS, PC A05/MF A01.

The Western Conifers Research Cooperative is part of the national Forest Response Program (FRP). The FRP is a federal program designed to determine the current and potential effects of atmospheric deposition on forests in the United States. Research is conducted regionally within four research Cooperatives. The Western Cooperative is concerned with the effects of atmospheric deposition on coniferous forests in the eleven conterminous western states. The 1987 Research Plan first outlines the objectives and research strategy of the FRP. The objectives and strategy of the Western Cooperative are then described in the context of the parent organization. The 1986 Western Cooperative program is reviewed followed by a description of the 1987 program. Brief descriptions of each of the individual 1987 research projects are also given.

6426 **(PB—87-227658/XAB) Mesoscale acid-deposition model: preliminary applications and a guide for user interface. Interim report, May 1985-April 1987.** Carmichael, G.R.; Peters, L.K. (Iowa Univ., Iowa City (USA). Dept. of Chemical and Materials Engineering). Aug 1987. 125p. NTIS, PC A06/MF A01.

In 1984 the U.S. EPA initiated a Mesoscale Acid Deposition Study. The study was organized to assess and understand the interactions and importance of local emissions in mesoscale precipitation scavenging. One important component of the project was the simulation of the field events using a detailed meteorological and chemical modeling framework (called MesoSTEM). A dynamical meteorological model, Mesoscale Atmospheric Simulation System (MASS) was used to predict the meteorological fields, including precipitation rates. These fields are used as inputs to a comprehensive chemical model Sulfur Transport Eulerian Model (STEM-II). The three-dimensional models are used to quantify the relationships between emissions, chemical production, and wet deposition on the mesoscale. The linkage of the models, and the application of MesoSTEM to the May 2nd and 3rd, 1985 Philadelphia Mesoscale Field Study data set is the subject of the report.

6427 **(PB—87-227682/XAB) Contributions of the Fluid Modeling Facility to EPA's (Environmental Protection Agency's) complex-terrain model development program.** Snyder, W.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Aug 1987. 64p. (EPA—600/3-87/026). NTIS, PC A04/MF A01.

The contributions of the EPA Fluid Modeling Facility (FMF) to the Complex Terrain Model Development Program (CTMDP) are described. These contributions included a wide range of laboratory studies and a limited amount of numerical modeling of flow and diffusion in neutral and stably stratified conditions in complex terrain. The goal of the CTMDP is the development of a dispersion model valid in complex terrain, with emphasis on plume impaction on nearby hills during nighttime stable conditions. Work at the FMF prior to the inception of the programs provided the basic framework for the model - the dividing-streamline concept - and the focal point around which the field program was designed. Throughout the course of the CTMDP, the FMF interacted vigorously with the model developers by providing support in various ways. Simultaneously, the FMF responded to the needs of the EPA Office of Air Quality Planning and Standards (OAQPS) by providing guidance concerning expected terrain effects and by conducting demonstration studies. Finally, several supplemental studies were conducted, broadening and expanding upon the specific requests of the model developers and the OAQPS.

6428 **(PB—87-228136/XAB) CEMS (continuous emission monitoring systems) pilot project: evaluation of opacity CEMS reliability and QA (quality assurance) procedures. Volume 1.** Peeler, J.W. (Entropy Environmentalists, Inc., Research Triangle Park, NC (USA)). May 1986. 128p. NTIS, PC A07/MF A01.

A study was conducted in Missouri to evaluate the reliability of opacity-monitoring data and to facilitate the development and evaluation of QA procedures for opacity CEMS's. The study included opacity CEMS's installed on six coal-fired electric utility generating units at four generating stations, each owned by a different company. The sources were representative of a wide range of monitoring applications and conditions, and were equipped with contemporary opacity monitoring instrumentation. For each station, monitor- and source-specific opacity CEMS QA procedures were developed and CEMS audits were conducted at the beginning of

the study. Plant personnel implemented and revised the QA procedures and conducted a performance audit during a 6- to 8-month period. Performance audits were also conducted at the end of the study. The report presents evaluations both of opacity CEMS reliability (i.e., accuracy, precision, and availability) and of the QA procedures that were used in the study. In summary, appropriate and effective QA procedures can be developed and implemented for a variety of opacity monitoring equipment and applications without imposing an undue burden on the monitor operators. Such procedures are inherently source- and monitor-specific. Reliable opacity monitoring data are obtained when appropriate QA procedures are implemented.

6429 **(PB—87-228409/XAB) Episodic emissions data summary. Final report, March-June 1987.** Howle, R.H.; Nash, R.A. (Radian Corp., Research Triangle Park, NC (USA)). Jun 1987. 188p. (RAD—87-231-020-17-30). NTIS, PC A09.

The report presents a complete summary of episodic emissions data collected by the Environmental Protection Agency (EPA) under the authority of Section 114 of the Clean Air Act (CAA). Episodic emissions data were collected for the production and use of nine potentially hazardous organic compounds: methylene chloride (MC), carbon tetrachloride (CT), chloroform (CF), perchloroethylene (PCE), trichloroethylene (TCE), ethylene dichloride (EDC), butadiene (BD), ethylene oxide (EO), and epichlorohydrin (EPI). These chemicals and data are reported in 13 source categories that best describe the scope of use of these chemicals.

6430 **(PB—87-228508/XAB) Total-mass emissions from a hazardous-waste incinerator.** Trenholm, A.; Lapp, T.; Scheil, G.; Coates, J.; Klomm, S. (Midwest Research Inst., Kansas City, MO (USA)). Aug 1987. 233p. NTIS, PC A11/MF A01.

Past studies of hazardous-waste incinerators by the Hazardous Waste Engineering Research Laboratory have primarily examined the performance of combustion systems relative to the destruction and removal efficiency (DRE) for Resource Conservation and Recovery Act (RCRA) Appendix VIII compounds in the waste feed. These earlier studies demonstrated that, in general, most facilities performed quite well relative to the DRE. However, subsequent review by the Environmental Protection Agency's (EPA) Science Advisory Board raised questions about additional Appendix VIII or non-Appendix VIII constituents that were not identified in the earlier tests and might be emitted from hazardous-waste combustion. The report presents results of a characterization of incinerator effluents to the extent that the emitted compounds can be identified and quantified. Measurements were made of both Appendix VIII and non-Appendix VIII compounds in all effluents (stack, ash, water, etc.) from a full-scale incinerator.

6431 **(PB—87-228656/XAB) Prevention reference manual: control technologies. Volume 1. Prevention and protection technologies for controlling accidental releases of air toxics. Final report, November 1986-June 1987.** Davis, D.S.; DeWolf, G.B.; Quass, J.D. (Radian Corp., Austin, TX (USA)). Aug 1987. 297p. (DCN—87-203-023-62-20). NTIS, PC A13/MF A01.

The volume discusses prevention and protection measures for controlling accidental releases of air toxics. The probability of accidental releases depends on the extent to which deviations (in magnitude and duration) in the process can be tolerated before a loss of chemical containment. Developing a satisfactory control system and equipment capable of withstanding deviations requires adherence to sound process and physical-plant design principles and to appropriate procedures and management practices. A process can be controlled by manipulating flow, temperature, pressure, composition, and quantity. A control system can be improved by improving the quality, specifications, and maintenance of physical components, and by duplicating components where warranted. The probability of equipment failure (causing a release) can be reduced by considering various aspects of physical-plant design. Finally, protection system technologies (e.g., flares, scrubbers, and enclosures) offer a last line of defense against accidental toxic chemical releases.

6432 **(PB—87-229647/XAB) Extent-of-exposure study: 1,3-butadiene monomer production industry.** Krishnan, E.R.; Ungers, L.J.; Morelli-Schroth, P.A.; Fajen, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 100p. (IWS—147.04). NTIS, PC A05/MF A01.

A new sampling and analytical method developed by NIOSH was used to assess exposure to 1,3-butadiene; the method is not susceptible to interference from four other carbon compounds and has a lower quantitation limit of 0.02 parts per million (ppm). Walk-through surveys were conducted at ten 1,3-butadiene monomer-production facilities, followed by in-depth surveys at four of the facilities. For all job categories, full-shift exposures were below the OSHA permissible exposure limit of 1000 ppm. For all job categories, geometric-mean full-shift exposures were below the threshold limit value of 10 ppm; however, some individual exposures for process and laboratory technicians exceeded 10 ppm. The authors recommend adoption of several control measures; conversion to closed-loop sampling systems; use of dual mechanical seals on pumps; use of magnetic gauges for rail-car filling; conducting cylinder voiding using a laboratory hood or vacuum hood; and use of respirators during maintenance of process equipment.

6433 **(PB—87-230660/XAB) Program to calculate size-specific particulate emission factors for mobile sources (for microcomputers). Software.** Adler, J. (Environmental Protection Agency, Ann Arbor, MI (USA). Motor Vehicle Emission Lab.). May 1987. vp. NTIS CP D02.

Supersedes PB—86-179702; The Software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM XT microcomputer. Diskettes are in ASCII format. Price includes documentation, PB—86-179694.

The methodology and sources of data for the program are described in detail in the report, Size-Specific Total Particulate Emission Factors for Mobile Sources, prepared in August, 1984 for EPA by EEA. That report describes the calculation of particulate emission factors for each of the six vehicle classes used in the program. It also provides emission factors for each major type of particulate (lead, organic, sulfate, and diesel composite). The program inputs and format are designed to parallel those found in MOBILE 3. User inputs include scenario year, vehicle speed, driving conditions, and particle-size range. By setting control flags the user can elect to replace the default data with locality specific data...Software Description: The program is written in the FORTRAN programming language for implementation on IBM-XT or compatible microcomputer.

6434 (SERI/CP—233-2959, pp 195) **Application of ^{2}H-proteins to PMR analysis of complex systems.** Crespi, H.L. (Argonne National Lab., IL). 1986. NTIS, PC A11/MF A01. Order Number DE87006421/JAW. (CONF-8606279—Summs.).

From 10. DOE solar photochemistry research conference; Ontario, Canada (8 Jun 1986).

Protein-protein and protein-nucleic acid interactions are key interactions in the control of cell metabolism. The complexity of these systems makes them difficult to study by proton magnetic resonance (pmr), one of the more powerful techniques for studying solution structure and dynamics. If one of the components of the complex could be per-deuterated, these systems would be more amenable to study by pmr. Fully deuterated plant microorganisms (cyanobacteria, bacteria, yeast and molds) have been available for some years. Higher plants and animals do not withstand high levels of D_2O. Thus, limited amounts only of plant proteins have been available, which restricted the application of perdeuterated proteins to interesting systems. But with the advent of genetic engineering using recombinant DNA techniques, mammalian, higher plant and other proteins are available in quantity in perdeuterated form. Several advantages accrue from using engineered bacteria. Yields of a particular product are high, which minimizes the need for large quantities of perdeuterated nutrient medium. Chemical and genetic manipulation of the product is easily done. They present here pmr results obtained with calmodulin, the first perdeuterated mammial protein, and with other systems.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5468, 5525, 5540, 5786, 5788, 5822, 6208, 6398, 6412, 6537

6435 **(HMI-B—439) Radioactivity measurements of the HMI after the Chernobyl reactor accident.** Behrend, U.; Dulski, P.; Friedland, E.M.; Gawlik, D.; Kirschfeld, K.E.; Schubert, P.; Steinmetz, K.H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). Jan 1987. 97p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750540/JAW.

The report explains the methods applied and the data measured by the HMI campaign. The material is presented so as to be of interest also to readers who in general are not concerned with aspects of radiation protection. The data measured refer to the local dose rate and to radioactivity in the environment (air, rain, surface waters, soil, food, mother's milk. Also, results of measurements of samples from Eastern Europe are given.

6436 **(PB—87-229639/XAB) Comparison of AIRDOS-EPA predictions of ground-level airborne radionuclide concentrations to measured values. Final report.** Hutson, D. (Faucett (Jack) Associates, Bethesda, MD (USA)). Aug 1987. 49p. (JACKFAU—341/12-87). NTIS, PC A03/MF A01.

See also PB—80-147838.

The precision of the AIRDOS-EPA code in predicting ground-level radionuclide concentrations at varying distances from the source is high, after adjustment for incorrectly specified source characteristics or possible measurement bias at each site. The precision of the model is best measured by the constrained regression of adjusted predicted values versus measured values for all sites. The coefficient of determination (R2) of this regression is 0.77 with a slope of 0.92, indicating that the predicted concentrations are statistically equivalent to the measured values after adjustment of site-specific bias. At the 50% confidence level, the predicted concentrations at all sites are within 50% of the measured values after adjustment.

6437 **(PNL—6358) Idaho radionuclide exposure study: Literature review.** Baker, E.G.; Freeman, H.D.; Hartley, J.N. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002573/JAW.

Phosphate ores contain elevated levels of natural radioactivity, some of which is released to the environment during processing or use of solid byproducts. The effect of radionuclides from Idaho phosphate processing operations on the local communities has been the subject of much research and study. The literature is reviewed in this report. Two primary radionuclide pathways to the environment have been studied in detail: (1) airborne release of volatile radionuclides, primarily ^{210}Po, from calciner stacks at the two elemental phosphorus plants; and (2) use of byproduct slag as an aggregate for construction in Soda Springs and Pocatello. Despite the research, there is still no clear understanding of the population dose from radionuclide emissions, effluents, and solid wastes from phosphate processing plants. Two other potential radionuclide pathways to the environment have been identified: radon exhalation from phosphogypsum and ore piles and contamination of surface and ground waters. Recommendations on further study needed to develop a data base for a complete risk assssment are given in the report.

6438 **(RFP—4066) Study plan for the sensitivity analysis of the Terrain-Responsive Atmospheric Code (TRAC).** Restrepo, L.F.; Deitesfeld, C.A. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 18 Aug 1987. Contract AC04-76DP03533. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002487/JAW.

Rocky Flats Plant, Golden, Colorado is presently developing a computer code to model the dispersion of potential or actual releases of radioactive or toxic materials to the environment, along with the public consequences from these releases. The model, the Terrain-Responsive Atmospheric Code (TRAC), considers several complex features which could affect the overall dispersion and consequences. To help validate TRAC, a sensitivity analysis is being planned to determine how sensitive the model's solutions are to input variables. This report contains a brief description of the code, along with a list of tasks and resources needed to complete the sensitivity analysis.

6439 **Understanding the origin of radon indoors - building a predictive capability.** Sextro, R.G. (Lawrence Berkeley Lab., CA, USA). *Atmospheric Environment;* 21: No. 2, 431-438(1987).

Indoor radon concentrations one to two orders of magnitude higher than the U.S. average of approx. 60 Bq m^{-3} are not uncommon, and concentrations greater than 4000 Bq m^{-3} have been observed in houses in areas with no known artificially-enhanced radon sources. In general, source categories for indoor radon are well known: soil, domestic water, building materials, outdoor air and natural gas. Soil is thought to be a major source of indoor radon, either through molecular diffusion or convective flow of soil gas. While soil gas flow into residences has been demonstrated, no detailed understanding of the important factors affecting the source strength of radon from soil has yet emerged. Preliminary work has identified a number of likely issues, including the concentration of radium in the soil, the emanating fraction, soil type, soil moisture content, and other factors that would influence soil permeability and soil gas transport. This paper reviews the preliminary work that has been done to identify important soil and building characteristics that influence the migration of radon and outlines the areas of further research necessary for development of a predictive method.

6440 **A model for radiological risk assessment from transportation of radioactive material.** Mancioppi, S.; Piermattei, S. (ENEA, Direzione Sicurezza Nucleare e Protezione Sanitaria, Roma). pp 469-472 of Proceedings of the conference on physics in environmental and biomedical research. Onori, S.; Tabet, E. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8511239—).

From Physics in environmental and biomedical research conference; Rome, Italy (26 Nov 1985).

The transport of radioactive materials is an important step in every practice involving the use of nuclear energy. The record of safety until now attained is undoubtedly satisfactory; however being large quantities of radioactive substances transported every day throughout the world, it was deemed worthwhile to evaluate the radiological impact connected with the transport of radioactive materials. The International Atomic Energy Agency, as the Agency issuing the Regulations applied by almost all the national and international transport organizations, sponsored a study aimed to develop a model for the evaluation of the risk connected with the transport activity. A code INTERTRAN (International Transport) has been developed by a Swedish research group (1) and is mainly based on a code (Radtran) developed at Sandia Labs. Other research groups like US and Italy offered their cooperation in the preparation of the code. It appears that the collective dose equivalents involved in the shipments of all wastes to their hypothetical final destination are rather low (40 person-rem in the worst case) and do not depend strongly from the transport mode. Handlers and crew are the most exposed group as it was expected, while the dose contribution to the general public is negligible. The situation could change in case of accident as accident dynamic and accident rate strongly depend on the mode of transport; it might happen that in this case one transport mode could be preferred to another. It is therefore deemed very important to deserve great attention to accident analysis, taking into account also the fact that there exists a category of flammable waste. Our future studies are oriented in this direction.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 5684, 6970

5006 Regulations

REFER ALSO TO CITATION(S) 6414, 6440, 6556, 6557

6441 (PB—87-220943/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on occupational standard for benzene, by E. Baier, July 25-26, 1977. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 25 Jul 1977. 19p. NTIS, PC A02/MF A01.

The effects of occupational exposure to benzene on human health are discussed. After a brief mention of earlier findings, most of the testimony revolved around an ongoing mortality-pattern study of workers exposed to benzene during the manufacture of a natural rubber cast film with the trade name Pliofilm. The cohort demonstrated a five-fold excessive risk of total leukemia and a ten-fold excess of myelogenous and monocytic leukemias combined. Employees' 8-hour time-weighted average exposures were fairly consistent with the recommended standard in effect at that time. In areas where excessive concentrations of benzene occurred, respiratory protection was required. A modification was recommended in the sampling and analytical method recommended by NIOSH in the criteria document. According to the testimony, employees should be educated as to the potential dangers from benzene exposure, continuing education programs should be in place, and monitoring and recording of engineering control data should be emphasized to assure that engineering controls are effective and working properly.

6442 (PB—87-222634/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on proposed standard for occupational exposure to cotton dust, by R. Lemen, September 21, 1983. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 21 Sep 1983. 11p. NTIS, PC A02/MF A01.

Testimony was presented to support the need for a cotton dust standard to cover the waste-utilization industry and cottonseed oil mills. The following steps were presented to protect against diseases caused by exposure to cotton dust: worker exposure to cotton dust was to be reduced to the lowest level feasible; medical monitoring was to be undertaken and workers who were particularly susceptible to cotton-dust diseases were to be removed from contact with the dust; smoking was to be discouraged. A series of cross-sectional respiratory morbidity studies was conducted to determine the existence of byssinosis and other pulmonary disease among individuals involved with nontextile industrial exposure to cotton dust. Vertical elutriators were used to provide correlation of dust concentrations in the work environment and the rest of the results of the medical survey tests. Workers in the waste-utilization industry had a higher prevalence of bronchitis and results in pulmonary function tests which indicated lung damage. In cottonseed oil mill workers, an increased number of adverse respiratory effects were noted with decreased pulmonary function test results. While there were no data regarding dose response relationships for these industries, NIOSH recommended the institution of a sound prevention strategy.

6443 (PB—87-222642/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on occupational exposure to asbestos, by R. Lemen, June 21, 1984. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 21 Jun 1984. 18p. NTIS, PC A02/MF A01.

The testimony opened with a historic review of the development of asbestos exposure standards for workers in the United States. Current data indicated that larger doses of asbestos produced greater biological effects than smaller doses. However, uncertainty in exposure estimation has been a problem due to changes in methods of measuring exposure and the inability to compare results based on different sampling techniques. While respirators were felt to be effective in reducing employee exposures, there were problems in using or selecting the proper ones to use. The proposed standard was designed to reduce the risk of workers developing asbestos-related disease by considering the estimated probability of developing significant disease following a given cumulative exposure; by comparing the risk estimate with the health and safety risks in workers in non asbestos producing or using industries; and by understanding the technical limits of reliable sampling and analysis.

6444 (PB—87-222659/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on arsenic, by R. Lemen, July 14, 1982. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 14 Jul 1982. 6p. NTIS, PC A02/MF A01.

Evidence of the carcinogencity of arsenic prompted the recommendation by NIOSH in 1975 of an exposure limit of 2 micrograms/cubic meter (microg/m3) for a 15-minute sampling period. In 1978, the OSHA standard was set at 10 microg/m^3. OSHA concluded in 1982 from the quantitative assessment that between 7.7 and 25 excess deaths per 1000 workers would result from lung cancer among employees exposed to arsenic at 10 microg/m^3 over a working lifetime. NIOSH contended that by their statement of reduced exposure through good work habits, OSHA was concluding that a significant risk still existed at the proposed level of 10 microg/m^3 and that a person who was acting in his own best interests would seek to lower that exposure level still further. NIOSH urged that the recommended exposure level of 2 microg/m^3 be reconsidered and accepted.

6445 (PB—87-222667/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on OSHA (Occupational Safety and Health Administration) proposed rule for occupational exposure to benzene, by R. Lemen, March 20, 1986. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 20 Mar 1986. 12p. NTIS, PC A02/MF A01.

The testimony reviewed the history of benzene exposure and the development of recommended exposure limits. Data were reviewed on pharmacokinetics, cytotoxicity, long- and short-term exposures, and skin absorption of benzene. Benzene or its metabolites have been shown to remain in the body for a long period of time following inhalation exposure. Studies in mice revealed exposure-related increases in the frequency of sister chromatid exchanges and micronuclei at all exposure concentrations. Some epidemiological standards relating to the benzene standard were cited. NIOSH recommended that the Permissible Exposure Limit for benzene be reduced to 0.1 ppm as an 8-hour time-weighted average, and that there be a limit on short-term exposures of 1.0ppm for any 15-minute period. These recommendations were made to protect against inhalation of benzene and did not relate to skin absorption. Reports indicated that significant benzene absorption can result among workers exposed to solvents containing about 0.5 percent benzene. It was recommended that steps be taken to eliminate this route of exposure. The use of pressure-demand supplied air respirators with an auxiliary self-contained breathing apparatus or a pressure-demand apparatus was recommended.

6446 (PB—87-222790/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on OSHA (Occupational Safety and Health Administration) proposed rule for grain handling facilities; safety hazards, by R. Lemen, June 12-14, 1984. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 12 Jun 1984. 8p. NTIS, PC A02/MF A01.

Testimony was presented in support of the OSHA proposed rule on grain-handling facilities with the intent of mitigating fires, explosions, and other safety hazards. A description was given of the publication Occupational Safety in Grain Elevators and Feed Mills, followed by identification of several areas of special need. The study concluded that all-commodity generated dusts be considered hazardous until data demonstrated otherwise. The risk of explosions has been reduced in the industry through use of closed pneumatic systems to contain dusts. Worker and employer recognition of existing hazards was seen as vital. Entry into and working in confined spaces was to be prohibited until initial testing of the atmosphere in the space had been conducted. Reconsideration of the action level

for layered grain dust was encouraged as the currently acceptable action level of 1/8 inch was thought to be excessive due to the fact that dust accumulations of as little as 1/64 inch have supported secondary explosions when uniformly dispersed into the air. Rule clarification or changes were suggested to ensure that use of compressed air cleaning was prohibited and that portable vacuum cleaners were used to remove accumulated dust only if precautions were made to ensure that no potential source of ignition existed due to their use.

6447 **(PB—87-222832/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on proposed standard for coke oven emissions, by E. Baier, November 4, 1975.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 4 Nov 1975. 9p. NTIS, PC A02/MF A01.

The speaker testified that a total weight of particulate from a worker's breathing-zone sample would best serve as a screening device for workplace evaluation of exposure to coke oven emissions. It was recommend that an interim exposure level for total particulates be set at 0.5 to 0.7 mg/m^3. When test results exceed the limit, a benzene soluble fraction should be analyzed, using the existing 0.2 mg/m^3 standard. The recommendations also called for the benzo(a)pyrene content of the respirable particulate fraction to be analyzed twice yearly as an index for carcinogenic properties of this fraction. While it was acknowledged as difficult to determine which etiologic agent or agents would be most appropriately monitored, as the agents which cause the various types of cancer were unknown, consideration of the screening level based on total particulates, backed up by the benzene soluble standard as it currently existed, was recommended. Specific changes in standards included: extending medical surveillance to include maintenance workers; extending initial examinations to include urinary and skin symptoms such as bloody urine and skin photosensitization; extending pulmonary function tests to include forced expiratory volume in 1 second; and extending skin examinations for premalignant and malignant lesions and evidence of hyperpigmentation.

6448 **(PB—87-222865/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on occupational exposure to acrylonitrile, by R. Yodaiken, M.D., March 3, 1978.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 3 Mar 1978. 33p. NTIS, PC A03/MF A01.

Testimony was presented concerning the establishment of an occupational exposure standard for acrylonitrile (AN) to which an estimated 125,000 workers were potentially exposed. Two-year feeding and inhalation studies with animals indicated the chemical to be carcinogenic, producing tumors of the central nervous system (CNS), cerebral tumors, squamous cell neoplasms of the Zymbal gland, adenocarcinoma of the small intestine and large intestine, along with numerous benign tumors. Other findings included papillomata in the stomach, hemangioma of the kidney, fibroadenomas of the mammary gland, benign tumors of the uterus, and tumors of the ear canal. Teratogenicity studies indicated increased incidence of fetal malformation. Cases of AN as an allergen causing contact dermatitis and ulcers have been widely documented. It was recommended that drugs essential to the treatment of acute intoxication from AN be kept in the medical facility of all facilities using AN, and that employers institute a respiratory-protection program in accordance with requirements.

6449 **(PB—87-222873/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on proposed permanent standard for vinyl chloride, by M. Key, M.D., June 25, 1974.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 25 Jun 1974. 14p. NTIS, PC A02/MF A01.

Testimony was presented to aid in the determination of an acceptable level of exposure for vinylchloride. The testimony pertained to the areas of epidemiology and surveillance, sampling and analysis, respiratory protection, and exposure levels. Three deaths from angiosarcoma of the liver among polyvinyl-chloride (PVC) workers triggered the organization of a surveillance network to establish the number of deaths from this disease and its possible relationship to occupational exposure to VC and/or PVC. Average age at death for the PVC workers was 48.5 years. The estimated latent period for this disease was about 20 years. Other health effects from VC exposure may include a disabling liver fibrosis. Results of NIOSH Walk Through Surveys were briefly presented. A compilation of data from air sampling in seven PVC fabrication facilities showed that breathing zone samples ranged from 0.3 to 12ppm with a mean of 3ppm. Estimated time weighted average exposures were about 2ppm. Peak levels of at least 300ppm were noted. Extended exposures at these levels were not considered probable; however, maintenance and repair workers may experience such levels.

6450 **(PB—87-227542/XAB) On-site meteorological program guidance for regulatory modeling applications.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jun 1987. 187p. (EPA—450/4-87/013). NTIS, PC A09/MF A01.

The document provides EPA's guidance on the collection and use of on-site meteorological data for regulatory modeling applications. It forms the basis for the regulatory review of proposed meteorological monitoring plans by the EPA Regional Offices and States. The document contains comprehensive and detailed guidance for on-site meteorological measurement programs, covering initial design and siting of a system, through data recording and processing, up to air-quality-model input.

6451 **(STEV—1987-3) Less nitrogen oxides from combustion.** (Statens Energiverk, Stockholm (Sweden); National Swedish Environmental Protection Board, Solna). 30 Jan 1987. 132p. (In Swedish). (SNV—3312). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750413/JAW.

The National Enerrgy Administration and the National Swedish Environmental Protection Board have been commissioned to work out a program for the emission of nitrogen oxides from combustion plants with 30 percent by 1995. This report presents the suggested program and discusses environmental effects of nitrogen oxides, technical means for reducing the emissions, economic and administrative modes of actions et cetera. Suggested upper limits of emission are ,for new plants with yearly emissions above 300 tons: 0.005-0.10 NOsub(x)/MJ fuel and for smaller new plants: 0.10-0.20 NOsub(x)/MJ fuel. (L.E.).

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 5456, 5772, 5867, 6573

6452 **(IAEA-R—4124-F) Gamma-ray analysis for U, Th and K on bulk cutting samples from deep wells in the Danish Subbasin and the North German Basin. Final report for the period May 1985 - April 1986.** Lovborg, L. (Risoe National Lab., Roskilde, Denmark). (International Atomic Energy Agency, Vienna (Austria)). Jul 1987. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700611/JAW.

A total of 1329 bulk cutting samples from deep wells in Denmark were analysed for U, Th and K by laboratory gamma-ray analysis. Contamination of the samples by drilling mud additives, mud solids and fall down was studied by means of a wash down experiment and by comparison with the total gamma-ray response from wireline logging. It is concluded that the inorganic geochemistry on bulk cutting samples must be applied with great caution. The data are useful for geochemical characterization of well sections and for regional geochemical correlation. Radioelement abundance logs and radioelement ratio logs are presented from 3 wells in the Danish Subbasin and 2 wells in the North German Basin. The radioelement geochemistry is discussed for the successive lithostratigraphical units and a reference radioelement profile is established for the central part of the Danish Subbasin. Finally, a model describing the relationship between common lithofacies and their U content and Th/U ratio is suggested. The model deliniates the

depositional environment and the relative distances to the provenance areas. It is concluded that: (1) Uranium is mobile during deposition, but since then it is fixed by stable mineral phases at depth; (2) Thorium reflects source area characteristics and that any available ions are readily adsorbed by clay minerals. Thorium anomalies may thus serve as lithostratigraphical markers; (3) Potassium occurs in unstable rock forming mineral phases. The present distribution is controlled not only by the clastic mineral assemblage, but also by the diagenetic processes through geologic time. 34 refs, 21 figs, 8 tabs.

6453 **(ORNL/tr—87/26) Productivity of the plant cover of the earth, general regularities of its distribution and relation to climatic factors.** Bazilevich, N.I.; Drozkov, A.V.; Rodin, L.E. Translated from *Zhurnal Obshchei Biologii ;* **29**: No. 3, 261-271(1968). Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001541/JAW.

The general geographic regularities of the distribution of the biological productivity of the plan cover, (1) the reserve of green assimilating elements, (2) the total annual increment (in the aboveground and underground spheres), and (3) the annual increment in green assimilating elements, are subject to climatic factors, at the same time being determined by the biological characteristics of the plants. The values of these indices for zonal vegetation types are primarily regulated by the heat and moisture ratios. An increase in the indices of the total annual increment and also the increment in green mass of the plant communities is observed from the northern to the southern latitudes. The significance of the third major factor, which determines the living conditions of the plants, namely the influx of nutrients, is manifested particularly clearly in an analysis of the productivity indices of the intrazonal types of plant communities, under the conditions of cumulative land areas.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5514, 5668, 5772, 5866, 5959, 6413, 6475, 6488, 6549, 6553

6454 **(EPRI-EL/EA—5443-Vol.1) Analysis of polychlorinated dibenzofurans and polychlorinated dibenzo-p-dioxins in transformers and capacitors: Volume 1, PCDF/PCDD at New York State Health Department: Final report.** Hilker, D.R.; Eadon, G.A.; Aldous, K.M.; Smith, R.M.; O'Keefe, P.W.; Valente, H.; Connor, S.; Jurusik, J. (New York State Dept. of Health, Albany (USA). Wadsworth Center for Labs. and Research; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 107p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920051/JAW.

Seven samples of in-service utility fluids were analyzed for nineteen different polychlorinated dibenzofuran (PCDF) and polychlorinated dibenzo-p-dioxin (PCDD) compounds. Generated calibration plots for eight different individual compounds were linear over four orders of magnitude concentrations. Analyses in triplicate provided some insight on reproducibility of method. Spiked samples were analyzed with an average error of 28.9%, indicating that for the chosen analytes in this type of oily matrix, the method was quite reproducible and accurate. The relative standard deviation was less than 30% for more than 92% of the analyte determinations. The study showed that the samples of in-service utility fluids have considerably different PCDF-PCDD profiles. Maximum concentrations of tetrachlorodibenzofuran (TCDF) and tetrachlorodibenzo-p-dioxin (TCDD) were 1.2 and 0.001 mg/kg, respectively. Maximum concentrations of octachlorodibenzofuran (OCDF) and octachlorodibenzo-p-dioxin (OCDD) were 40 and 0.02 mg/kg, respectively. And two fluids contained barely detectable quantities of any PCDD or PCDF (maximum concentration: 0.003 mg/kg). 18 refs., 6 figs., 2 tabs.

6455 **(MST-LUFT-A—112) Ion balance in forest ecosystems.** Bille-Hansen, J.; Hovmand, M.F. (Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab.). Feb 1987. 100p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750388/JAW.

In 1985 a 5 years project was launched. 24 years old beech and Norway spruce stands were instrumented in two blocks of a species trial, a western block on old-pleistocene sandy deposits, and an eastern block on young-morainic loamy depostis. Essential parameters are wet and dry deposition of S-, and N-compounds and Cl/sup -/ as well as H/sup +/ and other cations. Rainfall, throughfall, stemflow, and litterfall are measured and chemically analysed. Also ambient atmospheric concentrations of SO/sub 2/, NO/sub 2/, O/sub 3/, and aerosols are determined. Soils are physically and chemically characterized and percolating soil water chemistry determined. The aim of the project is to estimate as precise as possible the ion-turnover in the systems. 32 refs.

6456 **(NEI-SE—11) Effect of acidification on the absorption of metals in plants and animals. Final report, MIL-3 project: the effect of acidification on the transport of metals in the environment.** (Lund Univ. (Sweden). Dept. of Geology). 1986. 41p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88750405/JAW.

From a general point of view the absorption of potentially toxic metals in the biomass does not increase as a result of the acidification of soils. The acidity of the soil however plays an essential role when absorbing some other metals, e.g. rubidium in plants. This has also been found in mushrooms, insects, birds and mammals. The intake of calcium and magnesium is reduced in acid soils whereas manganese shows a positive correlation with the pH-value of soils. The content of clay is important for the absorption of iron and aluminium, so that high content of clay will counteract reduction of the pH value. (G.B.).

6457 **(PB—87-227344/XAB) Measurement of hydrolysis rate constants for evaluation of hazardous-waste land disposal. Volume 2. Data on 54 chemicals.** Ellington, J.J.; Stancil, F.E.; Payne, W.D.; Trusty, C. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Aug 1987. 163p. NTIS, PC A08/MF A01.

See also Volume 1, PB—87-140349.

To provide input data for a mathematical model to estimate potential groundwater contamination from chemicals in land-disposal sites, hydrolysis rate constants were determined for 31 regulated chemicals under carefully controlled conditions. Hydrolysis rates were measured under sterile conditions at precisely controlled temperatures and at three pH levels (3, 7, and 11). Conditions were adjusted to provide sufficiently precise rate constants to meet modeling requirements determined through model sensitivity tests. In addition to close monitoring of temperature and pH, precautions were taken to minimize impact of adventitious processes. Chemical concentrations as a function of incubation time were measured by gas chromatography, liquid chromatography, or ion-exchange chromatography. Identities and purities of the chemicals were determined by mass spectrometry supplemented, in some cases, by infrared spectrometry.

6458 **(PB—87-227468/XAB) Analytical methods manual for the direct/delayed response project soil survey.** Cappo, K.A.; Blume, L.J.; Raab, G.A.; Bartz, J.K.; Engels, J.L. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Aug 1987. 327p. NTIS, PC A15/MF A01.

The U.S. Environmental Protection Agency, in conjunction with the National Acid Precipitation Assessment Program, has designed and implemented a research program to predict the long-term response of watersheds and surface waters in the United States to acidic deposition. On the basis of the research, each watershed system studied will be classified according to the time scale in which it will reach an acidic steady state, assuming current levels of acidic deposition. EPA requires that data-collection activities be based on a program which ensures that the resulting data are of known quality and are suitable for the purpose for which they are intended. In addition, it is necessary that the data obtained be consistent and comparable throughout the survey. For these reasons, the same detailed analytical methodology must be available to and must be used by all analysts participating in the study. The manual specifies the analytical methods and internal quality control used to process and analyze samples for the Direct/Delayed Response Project Soil Survey.

6459 **(PB—87-229688/XAB) Investigation of slurry-cutoff wall design and construction methods for containing hazardous wastes. Final report, September 1983-September 1986.** McCandless, R.M.; Bodocsi, A. (Cincinnati Univ., OH (USA). Dept. of Civil and Environmental Engineering). Aug 1987. 205p. NTIS, PC A10/MF A01.

The document reviews current design and construction methods of soil-bentonite slurry trench cutoff walls. It summarizes engineering practices, identifies areas of technical detail and initiates research to promote the development of standards for use of slurry walls to isolate hazardous waste. An instrumented slurry test column was developed and used to investigate the hydraulic characteristics of bentonite slurry seals formed, during construction, on cutoff trench walls. A slurry wall tank was used to evaluate the effects of overburden pressure and hydraulic gradient to evaluate the potential for self-remediation of hydraulic defects via in situ consolidation of soil-bentonite backfill.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5437, 5438, 5439, 5455, 5456, 5457, 5458, 5460, 5461, 5462, 5463, 5464, 5465, 5466, 5467, 5468, 5469, 5470, 5471, 5472, 5473, 5477, 5478, 5482, 5483, 5489, 5493, 5500, 5503, 5504, 5510, 5511, 5513, 5514, 5515, 5516, 5517, 5518, 5521, 5522, 5523, 5524, 5526, 5527, 5529, 5530, 5531, 5532, 5534, 5535, 5536, 5537, 5539, 5541, 5542, 5544, 5550, 5559, 5784, 5786, 5995, 6241, 6435, 6437, 6500, 6537

6460 **(EIR—628) Hydraulic conductivity, porosity and uranium retention of crystalline rock and marl: drill core infiltration experiments.** Bischoff, K.; Wolf, K.; Heimgartner, B. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1987. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700589/JAW.

The hydraulic conductivity and the dynamic porosity under mechanical stress have been measured on intact or fissure bearing crystalline rock cores from the NAGRA (National Cooperative for the Storage of Radioactive Waste) drilling programme in the central part of northern Switzerland along with marl cores from Oberbauenstock (Canton of Obwalden). Breakthrough profiles of uranium-233 on four of the crystalline samples have been established and in addition the immobilized activity was registered by α-autoradiography of sliced core samples. For the intact crystalline samples hydraulic conductivities were in the range of 1E-13 to 1E-11 m/s, whereas the marl displayed much smaller values of approx. 1E-15 m/s. The dynamic porosity in the crystalline cores is some 10 to 90 % of the total porosity, falling to 5 % in the marl sample. Calculations of apertures and surfaces of the conducting paths as well as an estimation of the coefficient of surface sorption were made by using the definition of the hydraulic radius and the relation between the overall (measured) retardation and the sorption coefficient, R = 1 + a/sub f/K/sub a/ (assuming a linear sorption isotherm), respectively. All four breakthrough profiles have been used in a separate publication to model radionuclide transport using the radionuclide transport model RANCHMD for two flow geometries. The measured and calculated profiles agree well; the extracted parameters are consistent with values from the literature and independent measurements. Here few parameters (apertures, surface and sorption coefficients) resulting from these calculations are compared with the values derived from the hydraulic radius concept. Alpha-Autoradiographs are shown to be helpful in typifying flow path geometries.

6461 **(RISO-R—540) Environmental radioactivity in Denmark in 1985.** Aarkrog, A.; Boelskifte, S.; Boetter-Jensen, L.; Dahlgaard, H.; Hansen, H.; Nielsen, S.P. (Risoe National Lab., Roskilde (Denmark)). Mar 1987. 146p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750350/JAW.

Strontium-90 was determined in samples from all over the country of precipitation, stream water, lake water, ground water, drinking water, sea water, dried milk, grain, bread, potatoes, vegetables, fruit, total diet, and human bone. Furthermore, /sup 90/Sr was determined in local samples of air, rain water, grass, sea plants, fish and meat. Cesium-137 was determined in air, precipitation, sea water, sediment, milk, grain products, potatoes, vegetables, fruit, total diet, sea plants, fish, and meat. Estimates of the mean contents of radiostrontium and radiocesium in the human diet in Denmark during 1985 are given. Tritium was determined in precipitation, stream water, lake water, drinking water, ground water and sea water. Technetium-99 and /sup 210/Po was measured in some marine samples. Radium-226 was determined in ground water. The γ-background was measured regularly by TLD, ionization chamber and on site γ-spectroscopy at locations around Risoe, at ten of the State experimental farms, along the coasts of the Great Belt and around Gylling Naes. The marine environments at Baersebaeck and Ringhals were monitored for /sup 137/Cs and corrosion products (/sup 58/Co, /sup 60/Co, /sup 65/Zn, /sup 54/Mn). 27 refs.

6462 **Plutonium and cesium radionuclides in sediments of the Savannah River Estuary.** Hayes, D.W.; Sackett, W.M. (Savannah River Lab., Aiken, SC, USA; University of South Florida, St. Petersburg, USA. Dept. of Marine Science). *Estuarine, Coastal and Shelf Science;* **25**: No. 2, 169-174(Aug 1987). Contract AC09-76SR00001.

A study was made of the ^{239}Pu, ^{240}Pu, ^{238}Pu and ^{137}Cs concentrations in tidal marsh sediments of the Savannah River estuary. Tidal marshes are identified as special locations for plutonium deposition because of the high biological productivity and relative stability of sediments as compared to channel sediments. The sup(239,240)Pu deposition averaged 3.2 mCi km^{-2} which is higher than land-based fallout values of about 2 mCi km^{-2}. The sup(239,240)Pu to ^{137}Cs ratio was about three times higher than fallout deposition estimates, indicating a more rapid desorption of ^{137}Cs from sediment in the saline waters of the area.

6463 **Reduction of plutonium(V) by aquatic sediments.** Penrose, W.R.; Metta, D.N.; Hylko, J.M.; Rinckel, L.A. (Argonne National Lab., IL, USA). *Journal of Environmental Radioactivity (London);* **5**: No. 3, 169-184(1987).

The reduction of plutonium (V) to the (III) or (IV) state proceeds very slowly in distilled water or filtered natural waters, but rapidly in the presence of natural sediments. The reaction rate is nearly first-order and is proportional to sediment concentration. Fresh or heat-dried (105°C) sediments mediated a rapid reduction reaction but ashed (500°C) sediments, silica, kaolin, alumina and goethite mediated much slower rates. Rare earths strongly inhibit the reduction; the affinity (inhibition) constant of neodymium for the reducing site is 4.5 x 10^{7} M^{-1}, whereas the affinity of neodymium for rare-earth binding sites is 5.0 x 10^{8} M^{-1}. Some hours of pre-equilibration of sediment and liquid phase are necessary to achieve constant reduction rates.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 5471, 5691, 5700, 5860, 5861, 5868, 5869, 5871, 5872, 5876, 6503, 6574, 6970

6464 **(DOE/ID—12110) Lichens of the Idaho National Engineering Laboratory.** Pearson, L.C.; Rope, S.K. (USDOE Idaho Operations Office, Idaho Falls. Radiological and Environmental Sciences Lab.). Sep 1987. 37p. NTIS, PC A03/MF A01. Order Number DE88002373/JAW.

A study begun in 1984 to evaluate the feasibility of using lichens to monitor air pollution at the Idaho National Engineering Laboratory (INEL) has provided good baseline data on the lichen flora of the site. To date, 111 lichen taxa, including 25 genera and 110 species, have been identified. Six genera (Agrestia, Heterodermia, Microthelia, Polyblastiopsis, Teloschistes, and Verrucaria) and 49 species were previously unrecorded in Idaho. A key to the lichen species of the INEL and a general description of the genera are included as appendices to this report. Voucher specimens of lichens found at the INEL are being stored at the Radiological and Environmental Sciences Laboratory. As of May 1987, 43 species have been curated in the lichen herbarium there.

5106 Regulations

REFER ALSO TO CITATION(S) 5471, 5489

6465 **(PB—87-232476/XAB) Potentially Responsible Party Search Manual. Final report.** (PRC Environmental Management, Inc., McLean, VA (USA)). Aug 1987. 678p. NTIS, PC A99/MF E04.

The Potentially Responsible Party (PRP) Search Manual provides guidance on the PRP search process including timing, content, basic methodologies, and problem resolution. It includes current agency policy affecting aspects of the search, examples, a glossary, a checklist that includes estimated LOE hours, and detailed information on data-base applications.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 5466

6466 **(BR—85(7.13)) The ecology of Barataria Basin, Louisiana: An estuarine profile.** Conner, W.H.; Day, J.W. Jr. (eds.). (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). Jul 1987. 183p. US Fish & Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. Order Number TI88900139/JAW.

The Barataria Basin lies entirely in Louisiana between the natural levees of the active Mississippi River and the abandoned Bayou Lafourche distributary. It is characterized by a network of interconnecting water bodies which allows transport of water, materials, and migrating organisms throughout the basin. Natural and artificial levees and barrier islands are the only high, well-drained ground in the basin, which is otherwise characterized by extensive swamp forests and fresh, brackish, and salt marshes. These wetlands and water bodies are extremely productive biologically and provide valuable nursery habitat for a number of commercial and recreational fish and shellfish, as well as habitat for wintering waterfowl and furbearers. The basin is a dynamic system undergoing constant change because of geologic and human processes. The network of bays, lakes, and bayous has gradually enlarged over time due to natural subsidence and erosion. Superimposed on these natural processes has been the construction of levees for flood control and network of canals constructed for oil and gas exploration and extraction. These human activities have altered natural hydrologic patterns in the basin and may directly or indirectly contribute to wetland losses. Controlling wetland deterioration in the basin is a major management concern.

6467 **(PB—87-234704/XAB) Measurement of proteolysis in natural water as an approach to the study of natural cycling and pollution impact. Technical completion report.** Sjogren, R.E. (Vermont Univ., Burlington (USA). Dept. of Microbiology and Biochemistry). Dec 1982. 18p. NTIS, PC A02/MF A01.

Studies were conducted using a spectrophotometric assay that utilizes a particulate chromogenic protein to detect and follow proteolytic activity of natural mixed bacterial populations from lake water. Seasonal changes in proteolytic rates were found to be related to lake turnover, algal blooms, and are dependent on the dominant proteolytic bacterium. In addition, temperature, but not pH changes, leads to changes in proteolytic rates. Addition of 100 micrograms per liter of orthophosphate leads to an increase in proteolytic rates by 54 percent, while the addition of metal cofactors leads to variable increases (about 5 percent) in rates when compared to control flasks. The addition of chemical contaminants generally leads to a reduction in the rate of proteolysis. Toxic heavy metals were also inhibitory. Recognition of the sensitivity of the assay to varying levels of added orthophosphate led to the development of a procedure for assessment of trophic state of freshwater ecosystems. Preliminary data demonstrate a reasonable correlation between biologically available phosphorus and trophic state.

6468 **(TR-EL—82-4/82-11-70) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest): Coho salmon.** Hassler, T.J. (Humboldt State Univ., Arcata, CA (USA). California Cooperative Fishery Research Unit). Aug 1987. 26p. NTIS, PC A03/MF A01. Order Number TI88900162/JAW.

This species profile summarizes taxonomy, morphology, distribution, abundance, life history, and environmental requirements of coho salmon in the Pacific Southwest (California). Coho salmon are anadromous and enter freshwater in fall to spawn, after liver in the ocean for two growing seasons. Spawning peaks in November to January. The fry hatch in spring and migrate to the ocean in about a year. Juvenile coho require a mixture of pools and riffles, abundant instream and bank cover, water temperatures of 10 to 15°C in summer, dissolved oxygen near saturation, and riffles with relatively little sediment and with abundant aquatic and terrestrial insects for food. Coho salmon support an extensive commercial and sport fishery. Habitats that support coho salmon are continually being destroyed or degraded; state, federal, and private agencies are working to restore and enhance these habitats.

6469 **(TR-EL—82-4/82-11-73) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (south Florida): Reef-building corals.** Porter, J.W. (Georgia Univ., Athens (USA). Dept. of Zoology). Aug 1987. 31p. NTIS, PC A03/MF A01. Order Number TI88900161/JAW.

Four species of reef-building corals are considered: elkhorn coral, staghorn coral, common star coral, and large star coral. All four species spawn annually in the fall during hurricane season. Juvenile recruitment is low in all four species. Rapid growth rates of species in the genus Acropora (10 to 20 cm/yr) contrast with slower growth rates of species in the genus Montastraea (1.0 to 2.0 cm/yr), but both species of Montastraea are also important in reef development due to their form and great longevity. Shallow-water colonies of Montastraea survive hurricanes; shallow colonies of Acropora do not. Because of their dependence on photosynthesis for all of their carbon acquisition, the Acropora species reviewed here have a more restricted depth distribution (0 to 30 m) than do the Montastraea species considered (0 to 70 m). All four species are subject to intense predation by the snail predator, Coralliophila. Species of Montastraea are susceptible to infection from blue-green algae, which produce "black band disease;" species of Acropora are susceptible to a different, as yet unidentified pathogen, that produces "white-band" disease. Increased water turbidity and sedimentation cause reduced growth rates and partial or whole mortality in all four species.

6470 **(TR-EL—82-4/82-11-74) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (north Atlantic): American eel.** Facey, D.E.; Van Den Avyle, M.J. (Georgia Univ., Athens (USA). Dept. of Zoology; Georgia Univ., Athens (USA). Georgia Cooperative Fish and Wildlife Research Unit). Aug 1987. 34p. NTIS, PC A03/MF A01. Order Number TI88900160/JAW.

The American eel is an ecologically and economically important catadromous species that occupies freshwater streams, rivers, brackish estuaries, and the open ocean during various phases of its life cycle. Adult eels apparently spawn in the Sargasso Sea, and ocean currents transport the developing larvae northward until the young metamorphose into juveniles capable of swimming shoreward and moving upstream into coastal areas, estuaries, and rivers. Developing eels commonly remain in freshwater or brackish areas for 10-12 years before migrating to spawn. American eels tend to be bottom-dwellers and feed on a variety of fauna that occupy the same habitats. Eels occupy areas having wide ranges of temperature, salinity, and other environmental factors, suggesting broad tolerance limits, but few studies of requirements have been reported. Salinity patterns and water currents created by river discharges into coastal areas apparently provide the gradient that cues shoreward migration of juvenile eels. Alteration of patterns of freshwater inflows to estuaries and bays could affect upstream migrations.

6471 **(TR-EL—82-4/82-11-75) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic): Hard clam.** Eversole, A.G. (Clemson Univ., SC (USA). Dept. of Aquaculture, Fisheries and Wildlife). Aug 1987. 39p. NTIS, PC A03/MF A01. Order Number TI88900159/JAW.

The hard clam, Mercenaria mercenaria, supports an important commercial fishery in the South Atlantic, averaging about 1 million kg of meats annually from 1979 to 1983. It also is an important constituent of estuarine systems throughout the region. Spawning occurs in the spring and the fall at 16 to 30°C. Planktonic eggs and larvae are carried by water currents, and larvae set sometime after 6 days of age. Mortality is highest in egg and larval stages, the most sensitive part of the life cycle. Spat display gregarious setting behavior and appear to select sand over finer substrates. Highest densities of clams occur in sandy bottoms with shell. Crab predation is an important factor influencing the density and distribution of clams. Blue crabs and mud crabs appear to be the most important predators. Hard clams are infested by few parasites. Adult clams feed by filtering suspended particulate matter from the water. Growth of clams decreases with size and age. Growth occurs year-round with peaks in spring and fall. Growth of adult hard clams occurs at 9 to 31°C and at 4 to 35 ppt (optima near 20°C and 24 to 28 ppt). Hard clams mature in 2 years and reach commercial size in 3 years in the South Atlantic. Tight-fitting shells permit hard clams to survive poor water quality for short periods.

6472 **(TR-EL—82-4/82-11-76) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (north Atlantic): Atlantic tomcod.** Stewart, L.L.; Auster, P.J. (Connecticut Univ., Groton (USA)). Aug 1987. 15p. NTIS, PC A02/MF A01. Order Number TI88900158/JAW.

The Atlantic tomcod (Microgadus tomcod) is of regional importance in a winter recreational sport fishery. Tomcod are widespread along coastal regions of the northeast coast of the United States. They are abundant in estuarine habitats such as river mouths and saltmarshes, and thus are subject to a wide variety of anthropogenic sources of disturbance. Tomcod spawn from November to March. Young-of-the-year remain in the estuary where they were spawned during succeeding summer months. Adults live in full-strength seawater to freshwater, but eggs and larvae have narrower salinity requirements.

6473 **(TR-EL—82-4/82-11-77) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (south Florida): Long-spined Black Sea urchin.** Ogden, J.C.; Carpenter, R.C. (Fairleigh Dickenson Univ., Christiansted, St. Croix (U.S. Virgin Islands). West Indies Lab.). Aug 1987. 24p. NTIS, PC A02/MF A01. Order Number TI88900157/JAW.

The long-spined black sea urchin, Diadema antillarum, is one of the most common marine invertebrates in the South Florida and Caribbean regions. Diadema is gregarious and is found in large groups on hard bottom in shallow waters. Spawning is year-round, concentrated in late winter to early summer, and the larvae spend an unknown period in the plankton. Following settlement, growth is rapid, to a maximum size of about 10 cm in 3 to 4 years. Diadema is a grazer, feeding on small algal filaments and on seagrass, and tends to be active at night. Grazing activities can produce grazed halos around patch reefs in the vicinity of seagrass beds. Many experiments have indicated the importance of this grazing in the coexistence of species on the reef and in maintaining high biological productivity. In 1983-84, Diadema suffered an unprecedented mass mortality and its populations were reduced by up to 98% throughout its range. The elimination of Diadema has affected algal biomass, reef productivity, and fish populations. Diadema populations are slowly beginning to increase, but complete recovery may take years.

6474 **(TR-EL—82-4/82-11-78) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): Common littleneck clam.** Chew, K.K.; Ma, A.P. (Washington Univ., Seattle (USA). School of Fisheries). Aug 1987. 29p. NTIS, PC A03/MF A01. Order Number TI88900156/JAW.

The common littleneck clam (Protothaca staminea) is important both in recreational and commercial fisheries in the Pacific Northwest region. This review describes the life history (spawning, egg and larval stages, postlarvae and juveniles, maturity, and life span), growth characteristics, commercial and sport fisheries, aquaculture, ecological role, and environmental requirements of the species. An updated literature cited section is also included.

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REFER ALSO TO CITATION(S) 5421, 5476, 5668, 5866, 5959, 5968, 5970, 6169, 6413, 6457, 6459, 6575

6475 **(AD-A—184391/1/XAB) Laboratory investigation of organic-contaminant immobilization by proprietary processing of Basin F Liquid, Rocky Mountain Arsenal, Denver, Colorado. Final report.** Myers, T.E.; Zappi, M.E. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Aug 1987. 24p. (WES/TR/EL—87-11). NTIS, PC A02/MF A01.

The applicability of a proprietary solidification/stabilization process to liquid from a hazardous-waste lagoon at the Rocky Mountain Arsenal, Denver, Colo., was investigated in laboratory studies. The proprietary process is cement-based and is commercially available from Hazcon, Inc., Houston, Tex. The effectiveness of the Hazcon process for solidification of Basin F liquid was evaluated using an unconfined compressive-strength test; its effectiveness for chemical stabilization of the organic content of the liquid was evaluated using batch leaching tests. The potential for ammonia release was also assessed by measuring ammonia gas concentrations in laboratory air during processing. The study was not designed to provide an evaluation of the capabilities of the Hazcon process for hazardous wastes in general.

6476 **(DOE/EV/70134—T11) Summary of past research performed at UCLA under support of DOE, Office of Marine Environment: Final report, 1967-December 1985.** Kaplan, I.R. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). [1987]. Contract AS03-76EV70134. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002312/JAW.

The studies have been basically aimed at a better understanding of the processes occurring at the sediment-water interface, the carbon budget in the ocean, the flux of the light elements, and the diagenetic changes of the sedimentary components. Recent research endeavors have focused on environmental problems relating to anthropogenic pollution of the southern California Bight as a result of petroleum exploration and production and shelf edge exchange processes and transport of carbon in the Atlantic shelf, slope and the rise. Brief summaries of research findings relating to southern California nearshore and offshore studies and to the Atlantic Shelf from this laboratory are presented with emphasis on the data generated within the last eight years.

6477 **(DPST—85-690) Burning/Rubble Pits: Environmental information document.** Huber, L.A.; Johnson, W.F.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 241p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88001370/JAW.

The Burning/Rubble Pits, located near each of the major operating areas at the Savannah River Plant (SRP), began collecting burnable waste in 1951. The waste was incinerated monthly. All Burning/Rubble Pits are currently closed except for Burning/Rubble Pit 131-1R, which has not been backfilled but is inactive. No soil cores from the Burning/Rubble Pits have been analyzed. There are four groundwater monitoring wells located around each of the pits, which have been sampled quarterly since 1984. The closure options considered for the Burning/Rubble Pits are waste removal and closure, no waste removal and closure, and no action. Modeling calculations were made to determine the risks to human population for the three postulated closure options. An ecological assessment was conducted to predict the environmental impacts on aquatic and terrestrial biota. The relative costs for each of the closure options were estimated. An evaluation of the environmental

impacts from the Burning/Rubble Pits indicates that the relative risks to human health and ecosystems for the postulated closure options are low. The ecological assessment shows that the effects of any closure activities on river water quality and wildlife would be insignificant. The cost estimates show the waste removal and closure option to be the most expensive for all of the pits. 38 refs., 35 figs., 47 tabs.

6478 **(DPST—85-696) Hydrofluoric Acid Spill Area: Environmental information document.** Huber, L.A.; Bledsoe, H.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001369/JAW.

The Hydrofluoric Acid Spill Area is located in the Central Shops Area of the Savannah River Plant (SRP). It is uncertain if a spill occurred at this site or if contaminated soil or containers were buried here. Soil cores from the Hydrofluoric Acid Spill Area have not been collected or analyzed. Four groundwater monitoring wells were installed around the spill area in 1984 and have been sampled quarterly since early 1985. The potential impacts of lead and fluoride were assessed because of their measured groundwater concentrations. The closure options considered for the Hydrofluoric Acid Spill Area are waste removal and closure, no waste removal and closure, and no action. The predominant pathways for human exposure to chemical and/or radioactive constituents are through surface, subsurface, and atmospheric transport. Modeling calculations were made to determine the risk to human population via these general pathways for the three postulated closure options. An ecological assessment was conducted to predict the environmental impacts on aquatic and terrestrial biota. The relative costs for each of the closure options were estimated. An evaluation of environmental impacts indicates that the relative risk to human health and ecosystems for the closure options analyzed is low. The ecological assessment shows that the effects of any closure activities on river water quality and wildlife would be insignificant. The cost estimates show that the waste removal and closure option is the most expensive ($890,000). The other two options are a factor of 8 less expensive. 30 refs., 14 figs., 34 tabs.

6479 **(DPST—85-701) Waste oil basins: Environmental information document.** Huber, L.A.; Johnson, W.F.; Bledsoe, H.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000760/JAW.

The Motor Shop Oil Basin, located in A Area at the Savannah River Plant (SRP), was constructed and placed in service in 1977 to receive liquid waste from the 716-A Motor Shop oil/water separator. The liquid wastes seeped naturally into the soil beneath the basin. In August 1983, all discharges to the oil basin were terminated. The D-Area Oil Basin is located near the major coal-fired power production facility at SRP. The basin was constructed in 1952 and began receiving waste oil products from D Area that may have contained hydrogen sulfide, chlorinated organics, and other chemicals. In 1975 the basin became inactive. Results from groundwater quality analyses indicate elevated levels of total organic halogens, which are attributed to chlorinated hydrocarbon contamination sources from nearby M Area. No soil cores from the D-Area Oil Basin have been collected or analyzed. Four groundwater monitoring wells have been installed at the basin and sampled quarterly starting in 1984. Slightly elevated levels of total organic halogens were detected in one of the wells. The closure options considered for the Waste Oil Basins are waste removal and closure, no waste removal and closure, and no action. An ecological assessment was conducted to predict the environmental impacts on aquatic and terrestrial biota. The relative costs for each of the closure options were estimated. An evaluation of environmental impacts from the D-Area Oil Basin indicates that the relative risks to human health and ecosystems for the postulated closure options are low. The maximum carcinogenic risk in all three groundwater pathways is from exposure to tetrachloroethylene (4.0E-08 HE/lifetime) for all closure options. The cost estimates show the waste removal and closure option to be the most expensive. 34 refs., 25 figs., 31 tabs.

6480 **(DTH-ISVA-Series Pap.—42) Conditional stochastic simulation of ground water contamination. A case study.** Rooy, D. van. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Stroemningsmekanik og Vandbygning). Dec 1986. 155p. NTIS (US Sales Only), PC A08. Order Number DE88750381/JAW.

A case of ground water contamination has been examined using deterministic and stochastic modelling techniques. The contamination is caused by leachate from an unprotected landfill that is situated in a highly-permeable unconfined aquifer. The transmissivity distribution is viewed as a randomly behaving autocorrelated field. Unconditional and conditional stochastic transport simulations are presented. Conditioning is done with regard to the transmissivity, hydraulic head and contaminant concentration observations. During the unconditional simulations it is explicitly assumed that the logtransmissivity field is governed by a stationary stochastic process. This is implicitly turned into a non-stationary process during the conditioning process, but no detailed description of its nature is required. A trade-off between the stochastic and deterministic transport approach is suggested, and the determining factor is the data available to constrain the simulations. In modelling terms this corresponds to a trade-off between advection and dispersion at the scale of resolution and larger scales. The practical implications of these findings are discussed and future work is recommended. (EG). 56 refs.

6481 (ESA-SP—258, pp vp) **Monitoring and modeling of the Adriatic Sea.** Debekkering, J.A. Dec 1986. NTIS, PC A14/MF A01. (ETN—87-90155; CONF-8606354—).

From ESA-EARSel Europe from space symposium; Lyngby, Denmark (25 Jun 1986).

A program to develop a spaceborne monitoring system to track coastal transport of pollution is outlined. Sensors used include the Coastal Zone Color Scanner on NIMBUS 6, the Advanced Very High Resolution Radiometers on NOAA 6 and 9, and the LANDSAT 5 Thematic Mapper. A model of the northern Adriatic Sea was developed. Image processing, and measuring campaigns are described.

6482 **(GAO/PEMD—86-6) The nation's water: Key unanswered questions about the quality of rivers and streams.** (General Accounting Office, Washington, DC (USA)). 1986. 163p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The federal government has spent approximately $37 billion to assist municipalities to construct and upgrade wastewater-treatment plants for the purpose of improving water quality in the nation's rivers and streams. The Environmental Protection Agency estimates that $109 billion will be required by the year 2000 to limit pollution from the plants. In this report, GAO pursued answers to four evaluation questions concerning the nation's water quality: (1) What is the present condition of the nation's water quality? (2) How has the nation's water quality changed over time? (3) What pollution sources degrade water quality? (4) What has been the effect of the Construction Grants Program on water quality? GAO was not able to draw definitive, generalizable conclusions on any of the questions because evaluating changes in the rivers and streams is difficult, the empirical data produced by the studies are sparse, and methodological problems reduce the usefulness of their findings.

6483 **(INIS-mf—10732) NOAMP (Northeast Atlantic monitoring program). Conditions of deep-sea dispersion of matter.** Mittelstaedt, E. (Deutsches Hydrographisches Inst. (DHI), Hamburg (Germany, F.R.)). 1986. 205p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750551/JAW.

The NOAMP project was to supply basic data for studies of the physical dispersion processes at deep-sea level. The data measured served as the basis for describing the dispersion and the transport of dissolved and particulate matter in the ocean. Although the study of the physical dispersion processes first was carried out regardless of the type of substances observed in the seawater, the project's main task was to especially study the dispersion of radioactive substances. The results reported show that measurable activi-

ty concentrations of the radionuclides cesium, strontium, plutonium, and tritium mainly occur in the troposphere of the ocean, within the upper 2000 m. At greater depths, the concentration is decreasing and at a level of more than 3000 m reaches the limit of detection of the measuring methods applied. The activities measured mainly result from the fall-out of the atmospheric nuclear weapons tests carried out twenty years ago. No connection could be established between the measured radioactivity concentrations and the dumping of low-level radioactive waste in this area of the North Atlantic.

6484 **(K/HS—200) K-1407-B and K-1407-C groundwater assessment plan.** Haymore, J.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Oct 1987. Contract AC05-84OT21400. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002171/JAW.

Several interim status surface impoundment groundwater monitoring wells at Oak Ridge Gaseous Diffusion Plant (ORGDP) showed statistically significant increases for the indicator parameters for groundwater contamination. Four downgradient wells at the K-1407-C surface impoundment indicated an increase in conductivity when compared with the upgradient background average; one of those wells also failed the statistical test when compared with itself. One downgradient well indicated the same type of increase at the K-1407-B surface impoundment. Additionally, one downgradient well at the K-1407-B impoundment indicated an increase in Total Organic Halogen (TOX) when compared wth the background data for that well. A false positive determination will be made for the conductivity increases and an off-site contamination determination will be made for the TOX.

6485 **(LA—11091-MS) Establishing a level of confidence for the analytical values for the trace metals in the Los Alamos Drinking Water Supply and Distribution System.** Robinson, R.; Knab, D. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000725/JAW.

The average recovery for all seven metals in each of the sample types was about 98%. However, the one-sigma relative standard deviations of those recoveries averaged 24% and 29% for known amounts of metals added as spikes versus 14% and 11% for the Environmental Protection Agency Performance Evaluation samples and control samples. That difference in standard deviation may be due to either analytical precision problems or matrix interferences. Most of the trace metal concentrations we observed in the Los Alamos Drinking Water Supply and Distribution System specimens were at least one order of magnitude below the maximum contaminant levels. The standard deviations obtained for the spike recoveries were much greater than desired. The program was to include all the drinking water sources and the secondary pollutant metals copper, iron, manganese, and zinc. 4 refs., 12 tabs.

6486 **(NEI-SE—7) Hydrographic periodicity in the bottom water of the Bornholm Basin.** Fonselius, S.H. (National Board of Fisheries, Goeteborg (Sweden). Inst. of Hydrographic). 1984. 11p. NTIS (US Sales Only), PC A02. Order Number DE88750400/JAW.

Since the 1960ies salinity and nutrients together with oxygen have been measured in the Bornholm basin of the Baltic sea by research ships from different countries. In the present paper the periodicity of these parameters in the bottom water has been studied. It is possible to distinguish seven periods with stagnant conditions. The stagnation periods begin with high salinities. The salinity then decrease slowly until it suddenly increases again, due to an inflow of Kattegat water along the bottom of the Belts and the Arkona basin. The periods have a duration of 3 to 4 years. The nutrient concentrations show the same periodicity due to accumulation during the stagnation periods. The nutrients studied, show differences in the accumulation pattern. (authors).

6487 **(NEI-SE—9) Energy forestry - disturbance or advantage for the water environment in the agricultural landscape.** Mare, L. de. (Lund Univ. (Sweden). Dept. of Zoophysiology). 10 Jan 1986. 20p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750408/JAW.

The leaching of nitrogen and phosphorus from an energy forest cultivation has been studied in the south of Sweden since the beginning of 1984. The water quality in ditches upstream and downstream energy forest cultivations have also been investigated. The investigations indicate that energy forests have positive effect on the leaching of nutrient salts. The decrease of leachates is explained by the high water uptake and long growing season of energy forests. (BoK).

6488 **(PB—87-228219/XAB) New Hampshire coastal program ocean and harbor segment and final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Apr 1982. 264p. (OCRM—87-2). NTIS, PC A12/MF A01.

The State of New Hampshire has submitted the Ocean and Harbor Segment of its Coastal Program to the Office of Coastal Zone Management for approval. Approval would allow program administrative grants to be awarded to the state, and would require that federal actions be consistent with the program. The document includes a copy of the program, which is a comprehensive management program for coastal land and water use activities. It consists of numerous policies on diverse management issues which are administered under existing state laws and is the culmination of several years of program development. The effect of these policies is to condition, restrict or prohibit various uses in parts of the coastal zone while encouraging development and other uses in other parts.

6489 **(PB—87-230165/XAB) Innovative and alternative technology projects: 1987 progress report.** (Environmental Protection Agency, Washington, DC (USA). Office of Municipal Pollution Control). Sep 1987. 71p. NTIS, PC A04/MF A01.

See also report for 1986, PB—86-247343.

The publication is issued annually to provide to interested parties with an overview of progress in the implementation of innovative and alternative technologies under provisions of the Clean Water Act. The report is based upon information from grant awards through April for the year issued as provided by state agencies and EPA regional offices.

6490 **(PNL-SA—14954) Solubility constraint concepts applied to leach testing of waste forms.** Serne, R.J.; Treat, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 6p. (CONF-870802—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000988/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Much current activity is devoted to the attempt to elucidate the governing processes that control the leaching of solid waste forms that are destined for burial in geologic media. This paper briefly discusses several types of release models that include mechanisms such as diffusion, desorption, solubility, and combinations of these three mechanisms. (ACR)

6491 **(Y/DZ—255/R1) Removal of low levels of mercury from aqueous solutions.** Napier, J.M. (Oak Ridge Y-12 Plant, TN (USA)). 1987. Contract AC05-84OS21400. 14p. (CONF-870245—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001820/JAW.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Water line breaks occurred in an obsolete process building that formerly used mercury as one of the process fluids. About one and one-half million gallons of water were collected. Some of it was stored in tanks and some stored in a concrete-lined sub-basement of the building. The stored water was contaminated with more than 100 ug/L (ppB) of mercury since the floors of the building were previously contaminated with mercury. A process to remove the mercury to less than 2 ug/L (ppB) and discharge the water to the environment was required. Several conventional processes were examined. A process was developed using ferrous sulfide loaded on ion-exchange resins. The water emitted from the modified ion-exchange resin was typically less than 1 ug/L (ppB) with most of the processes water containing less than 0.5 ug/L. 9 figs.

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REFER ALSO TO CITATION(S) 5463, 5464, 5466, 5467, 5468, 5478, 5489, 5493, 5517, 5528, 5544, 5786, 6098, 6462, 6463, 6490, 6537

6492 (DPST—85-693) Separations Area retention basins: Environmental information document. Scott, S.C.; Killian, T.H.; Kolb, N.L.; Corbo, P.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000759/JAW.

The Separations Area retention basins in areas of the Savannah River Plant were used from 1955 to 1973. These temporarily held water containing low levels of radioactivity. During the holding period, some of the wastewater seeped into the ground. The basins are currently out of service; the F-Area Retention Basin has been excavated and backfilled. ^{137}Cs and /sup 89,90/Sr were observed in the soil cores from the F-Area Retention Basin. ^{137}Cs, / sup 89,90/Sr, and ^{238}Pu were found in the soil cores from the H-Area Retention Basin. Water samples from the H-Area Retention Basin showed elevated levels of ^{134}Cs, ^{137}Cs, and ^{144}Ce. Two groundwater monitoring wells were installed adjacent to the perimeter of the H-Area Retention Basin. Very low levels of gross alpha and nonvolatile beta have been observed in these wells. The closure options considered are waste removal and closure, no waste removal and closure, and no action. Modeling calculations were made to determine the risks to human population for the three postulated closure options. An ecological assessment was conducted to predict the environmental impacts on aquatic and terrestrial biota. The relative costs for each of the closure options were estimated. The environmental impact evaluation indicates that the relative human health risks for all of the closure options considered are low. The ecological assessment shows that the effects of any of the closure activities on the terrestrial and aquatic systems would be insignificant. Cost estimates for the waste removal and closure option are $31.1 million and $21.3 million for the F-Area and H-Area basins, respectively. 36 refs., 14 figs., 52 tabs.

6493 (DPST—85-695) Bingham Pump Outage Pits: Environmental information document. Pekkala, R.O.; Jewell, C.E.; Holmes, W.G.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000758/JAW.

Seven waste sites known as the Bingham Pump Outage Pits located in areas of the Savannah River Plant (SRP) received solid waste containing an estimated 4 Ci of low-level radioactivity in 1957-1958. These sites were subsequently backfilled and have been inactive since that time. Most of the radioactivity at the Bingham Pump Outage Pits has been eliminated by radioactive decay. A total of approximately 1 Ci of activity (primarily ^{137}Cs and ^{90}Sr) is estimated to remain at the seven sites. The closure options considered for the Bingham Pump Outage Pits are waste removal and closure, no waste removal and closure, and no action. The predominant pathways for human exposure to chemical and/or radioactive constituents are through surface, subsurface, and atmospheric transport. Modeling calculations were made to determine the risks to human population via these general pathways for the three postulated closure options. An ecological assessment was conducted to predict the environmental impacts on aquatic and terrestrial biota. The relative costs for each of the closure options were estimated. Evaluation indicates that the relative human health risks for all closure options are small. The greatest public risk would occur after the waste site was released to unrestricted public use (assumed to occur in Year 2085) via the groundwater pathway to a well. The cost estimates show that the waste removal and closure option is the most expensive (89.6 million dollars). The cost of the no waste removal and the no action options is $800,000. 35 refs., 26 figs., 47 tabs.

6494 (GSF-HY—1/87) Annual report 1986 of the GSF Institute of Radiohydrometry. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Radiohydrometrie). Feb 1987. 300p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750559/JAW.

Sorption data of radionnuclides in cohesive materials are measured by batch experiments or by single-pass column experiments. New developments of equipment are explained, as for instance the H-2-uranium measuring device, the isotope dating of ground water with Ar-39, and measurement of Kr-35 in air. Field epxeriments are explained, such as studies of the fields of groundwater flow using tracer methods, hydrological methods and lysimeter techniques.

6495 (IAEA-R—3620-F) Study of the inter-relation between shallow and deep aquifers in Mardan Valley, Pakistan. Final report for the period 1 December 1983 - 31 December 1986. Ishaq Sajjad, M. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi). (International Atomic Energy Agency, Vienna (Austria)). Apr 1987. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700607/JAW.

This study concerns the determination of the relationship between shallow and deep aquifers in the Mardan Valley, in Pakistan. The environmental isotopes, /sup 18/O, /sup 2/H, /sup 3/H, /sup 14/C and /sup 13/C were used in conjunction with classical hydrogeological methods to determine the origins of the different groundwaters in the valley. The irrigation water contributes significantly to the water logging of the study area. There is also the evidence of upward leakage from the deep groundwater system which contributes to this effect. There is no evidence of contamination of the deep aquifers as the quality is good. Groundwater movement in the deep aquifer is slow in the order of tens of years. 5 refs, 21 figs, 2 tabs.

6496 (IAEA-R—3621-F) Isotopic investigation on the evolution of groundwater dynamics in the principal aquifers in the southern Dobrudja. Final report for the period 1 December 1983 - 30 November 1986. Tenu, A. (Institute of Meteorology and Hydrology, Bucharest, Romania). (International Atomic Energy Agency, Vienna (Austria)). Dec 1986. 102p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700608/JAW.

This study makes use of geology, tectonics, hydrogeology, hydrogeochemistry and environmental isotopes /sup 18/O, /sup 2/H, /sup 3/H, /sup 13/C and /sup 14/C to study the dynamics of groundwater in the southern Dobrudja region of Romania. The recharge areas of the various hydrogeologic units have been defined and the role of tectonic on groundwater circulation has been demonstrated. The existence of some areas with active ascending drainage along fractures has been proved. The Sarmatian groundwaters are recharged from surface waters while the Barremian-Jurassic aquifers are recharged from higher elevations as shown by the depleted stable isotope compositions. An actual flow velocity of V/ sub r/=0.8 m/year and an effective porosity of M/sub e/=0.12 were determined in the littoral region of the Sarmatian formation. The actual flow velocity varies from 2.6 m/year in the Baneasa zone to 5.4 m/year in the Pestera-Tortomanu region and reaching 11 m/year in the Plopeni-Mangalia zone. Groundwater flow directions have been mapped and conform to what is obtained from groundwater levels. 24 refs, 32 figs, 19 tabs.

6497 (INIS-mf—11049) Artificial radioactivity in the North Sea and the northern North Atlantic during the years 1977 to 1986. Kautsky, H. (Deutsches Hydrographisches Inst. (DHI), Hamburg (Germany, F.R.)). Nov 1986. 113p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700665/JAW.

The report presents a detailed survey of measured concentrations of /sup 137/Cs in the water of the North Sea in the title years. Depth profiles are included. The fundamental distribution pattern is largely constant. Data for /sup 90/Sr are given, also some data for /sup 239,240/Pu, /sup 238/Pu, /sup 241/Am and tritium. Clear water boundaries can be recognised. A transport time of 3 years between the Sellafield Works and the Pentland Firth is found, and a further year is needed to reach the southeastern North Sea. In 1984 the North Sea inventory of /sup 137,134/Cs was 2400 TBq. Transport time to Spitsbergen is 6-7 years and 7-9 years to east Greenland. 32 refs, 51 figs, 15 tabs.

6498 **(INIS-mf—11050) Worldwide data on fluxes of / sup 239,240/Pu, /sup 238/Pu to the oceans.** Aarkrog, A. (Risoe National Lab., Roskilde (Denmark)). Apr 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700666/JAW.

According to measurements (GEOSECS) the world's oceans contain approximately 16 PBq /sup 239,240/Pu, of which one-fourth is in the Atlantic and three-fourths in the Pacific Ocean. The expected inventory (from nuclear weapons testing) in the world's oceans is 12 PBq /sup 239,240/Pu including local fallout at the test sites. In the Irish Sea a local contamination of 0.3 PBq /sup 239,240/Pu from the Sellafield reprocessing plant resides in the sediments. No other sources than fallout and reprocessing add significantly to the /sup 239,240/Pu inventories in the oceans. The discrepancy between measurements and expectations are assumed to be due to an underestimate of the rainfall and dry fallout (seaspray) and thus of the Pu-deposition over the oceans, but may also to some degree be due to inadequate sampling. Refs, figs, tabs.

6499 **(INS-R—348) Assessment of the inventory of Carbon-14 in the oceans.** Lassey, K.R.; Manning, M.R.; O'Brien, B.J. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Apr 1987. vp. NTIS (US Sales Only), PC Axx/MF A01. Order Number DE88700671/JAW.

The oceanic inventory for natural /sup 14/C is 19.6x10/sup 29/ atoms, an estimate similar to those found by other methods. The /sup 14/C produced from nuclear weapons (1972) is 550x10/sup 26/ atoms and 52% was in the oceans. From 1972 to 1985 132x10/sup 26/ atoms of bomb /sup 14/C were added. The nuclear power industry produces 0.5x10/sup 26/ atoms per year (17% of natural production rate). Most estimates by varying methods indicate an exchange time of carbon from atmosphere to ocean of about seven years or about 22 moles m/sup -2/ yr/sup -1/ for the surface ocean. The oceanic distribution generally has higher concentrations in low to mid latitudes, and low concentrations in the most southern regions, with the deep ocean retaining levels similar to those before nuclear testing. Refs, figs, tabs.

6500 **(NUREG/CR—4786) Transport behavior of iodine in effluent radioactivity monitoring systems.** Edson, J.L.; Duce, S.W.; Tkachyk, J.W. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Sep 1987. Contract AC07-76ID01570. 32p. (EGG—2480). NTIS, PC A03/MF A01 - GPO. Order Number TI88001646/JAW.

Tests conducted on a mockup of the sample line of an effluent radioactivity monitoring system at a nuclear power plant are described. The tests evaluate the ability of the radioactivity monitoring system sample lines to transmit radioactive elemental iodine during transient conditions. The sample line was tested initially with manufacturing contamination left in the line; then was cleaned and retested to evaluate the effect of cleaning on transient performance. The sample line tested was of sufficient size to have acceptable performance during a nuclear reactor accident. The tests were conducted in a laboratory where radioactive iodine could be generated safely, test variables closely controlled, and test data measured. 5 refs., 11 figs., 9 tabs.

6501 **(PNL—6313) An evaluation of aquifer intercommunication between the unconfined and Rattlesnake Ridge aquifers on the Hanford Site.** Jensen, E.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002331/JAW.

During 1986, Pacific Northwest Laboratory conducted a study of a portion of the Rattlesnake Ridge aquifer (confined aquifer) that lies beneath the B Pond - Gable Mountain Pond area of the Hanford Site. The purpose was to determine the extent of intercommunication between the unconfined aquifer and the uppermost regionally extensive confined aquifer, referred to as the Rattleanake Ridge aquifer. Hydraulic head data and chemical data were collected from the ground water in the study area during December 1986. The hydraulic head data were used to determine the effects caused by water discharged to the ground from B Pond on both the water table of the unconfined aquifer and the potentiometric surface of the confined aquifer. The chemical data were collected to determine the extent of chemical constituents migrating from the unconfined aquifer to the confined aquifer. Analysis of chemical constituents in the Rattlesnake Ridge aquifer demonstrated that communication between the unconfined and confined aquifers had occurred. However, the levels of contaminants found in the Rattlesnake Ridge aquifer during this study were below the DOE Derived Concentration Guides.

6502 **Sup(239,240)Pu, ^{241}Am and ^{232}Th in lakes: the effects of seasonal anoxia.** Alberts, J.J.; Pinder, J.E. III; Bowling, J.W.; Nelson, D.M.; Orlandini, K.A. (Georgia Univ., Sapelo Island, USA. Marine Inst.; Savannah River Ecology Lab., Aiken, SC, USA; Argonne National Lab., IL, USA). *Journal of Environmental Radioactivity (London);* **4**: No. 3, 167-176(1986).

A pond which undergoes seasonal anoxia as a result of thermal stratification was studied to assess the possible release of actinide elements from anoxic sediments to the pond waters. Concentration profiles of sup(239,240)Pu, ^{241}Am, ^{232}Th, iron and manganese in the water column show significant increases in concentration for all elements in the anoxic deep waters. However, calculated total inventories of the elements in the pond water indicate no apparent input of actinide elements to the system during summer stratification. Similar inventory calculations for sup(239,240)Pu, in a previously studied system support the results of this study. The lack of a significant increase in pond inventories of actinide elements coupled with a lack of correspondence of concentration profiles of the actinide elements to the seasonal Fe and Mn concentration profiles argues that the increases in concentrations observed for these elements in anoxic bottom waters result from the downward transport of material already in the water column rather than release from the sediments.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 6545, 6546

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 5476, 5869, 6477, 6478, 6479, 6484, 6492, 6493

6503 **(ORNL—6411) User's manual for the defense priority model.** Smith, E.D.; Barnthouse, L.W. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 104p. NTIS, PC A06. Order Number DE88001493/JAW.

The US Air Force's Installation Restoration Program (IRP) requires the identification and evaluation of sites where hazardous materials were disposed in the past. In Phase I of the IRP, a hazard screening system known as the Hazard Assessment Rating Methodology (HARM) is used to identify sites containing hazardous waste and to rank these sites with respect to their potential environmental hazard. Field studies to obtain information on the extent of environmental contamination are now being conducted at sites identified by HARM as potentially hazardous. Oak Ridge National Laboratory has developed a modification and extension of the HARM system, referred to as the "Defense Priority Model" (DPM), which is intended to permit the use of site-specific monitoring data to refine priorities for further study. In DPM, the health and ecological hazards of contaminants identified through monitoring are assessed using toxicological benchmarks and bioaccumulation factors that relate the concentrations measured to concentrations or doses that may be toxic. This user's manual provides (1) detailed instructions for rating contaminated sites using DPM, (2) worked-out examples of DPM applications, (3) lists of toxicity benchmarks and bioaccumulation factors for hazardous chemicals identified at Air Force installations, and (4) blank score sheets. 12 refs., 6 figs., 10 tabs.

5206 Regulations

REFER ALSO TO CITATION(S) 5489, 5969, 6465, 6482

6504 **(PB—87-228532/XAB) Ground-Water Data Requirements Analysis for the Environmental Protection Agency. Appendices.** Dee, N.; Miller, C.; Kern, T.E.; Schisler, G.; Tasker, C. (Environmental Protection Agency, Washington, DC (USA)). May 1987. 209p. NTIS, PC A10/MF A01.

See also PB—87-228540.

The appendices provide the basis of the analysis and foundation for the findings, recommendations, and conclusions of the Ground-Water Data Requirements Analysis study. The detailed background and source material provided is the result of a thorough document review and the conduct of over 300 structured interviews with EPA Headquarters, Regions, state governments, local governments and other federal organizations.

6505 **(PB—87-228540/XAB) Ground-Water Data Requirements Analysis for the Environmental Protection Agency. Management data analysis report.** Dee, N.; Miller, C.; Kern, T.E.; Schisler, G.; Tasker, C. (Environmental Protection Agency, Washington, DC (USA)). May 1987. 64p. (EPA—440/6-87/005). NTIS, PC A04/MF A01.

See also PB—87-228532.

The study defines a management framework and data utility the EPA and states can use to store, share, and manipulate groundwater data to support better environmental decision making, and identifies specific initiatives by which the framework can be implemented.

53 Social And Economic Studies

REFER ALSO TO CITATION(S) 5880, 5936, 6968, 6969

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 5772, 5920

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 5577, 6544, 6550

6506 **(INIS-mf—10742) Radioactive marking of proteins in cultured mouse embryos.** Nowak, J. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Biologie). 27 Jul 1984. 135p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751016/JAW.

The purpose of this work was to build an in vitro test system, with which on the one hand postimplantation embryos of the mouse could be cultured without morphological of physiological damage and on the other hand their protein could be as highly marked as possible. With this radioactively marked proteins were to be won, which are optimally suited for a high separation by two-dimensional electrophoresis. In addition incubation and preparation methods were found for the ages of day 10, 11 and 12 of the embryonic development. With the use of /sup 3/H-marked amino acids in the culture medium it was determined that embryos without embryonic membranes, so-called N-embryos, built in more radioactivity into their proteins than the embryos with embryonic membranes, the so-called DAO-embryos or the DO-embryos. On the contrary, the embryos with intact blood circulation (DO-embryos) showed an even distribution of radioactive marker in their bodies. Since an even distribution of the marker in the embryo is a necessary prerequisite for a representative presentation of the proteins by 2DE, the DO-preparation was considered the best suited method. In order to increase the amount of radioactivity incorporated into the proteins of the DO-embryos, the concentration of the used isotope or the incubation length could be increased. A combination of both proved to be the best method. A /sup 14/C-marked amino acid mixture of 20 μCi/corresponds to 20 μl instead of the usual 150 μCi /sup 3/H-marked amino acids in a culture medium proved to be equally suitable. Notable changes which would have indicated a damaging affect of the used radioactivity or the in vitro culturing were not observed. The achieved methodical conditions were used for the presentation of the embryo proteins by two-dimensional electrophoresis and fluorography.

6507 **Mechanism of 2-aminopurine mutagenesis in mouse T-lymphosarcoma cells.** Caras, I.W.; MacInnes, M.A.; Persing, D.H.; Coffino, P.; Martin, D.W. Jr. (Howard Hughes Medical Institute Genetics Lab., and the Departments of Medicine, Microbiology and Immunology, and Biochemistry and Biophysics, Univ. of California, San Francisco, San Francisco, CA 94143). *Molecular and Cellular Biology;* 2: No. 9, 1096-1103(Sep 1982).

The authors investigated the mechanism of action of 2-aminopurine (Apur) in eurocaryotic cells. By analogy with studies in procaryotic systems, the base analog is presumed to incorporate into DNA predominantly opposite T where, upon subsequent DNA replication, it can mispair with C, inducing an A:T → G:C transition. This model predicts that Apur-induced mutagenesis will be enhanced by factors that favor formation of Apur-C mispairs, e.g., high levels of dCTP or low levels of TTP. We describe the use of a mutant T-lymphosarcoma cell line, AraC-6-1, which has an abnormally high dCTP pool and a low TTP pool, to test this prediction. AraC-6-1 cells were three- to fivefold more mutable by Apur than their parental cell line, NSU-1. This enhanced mutability by Apur could not be explained by altered incorporation of /sup 3/H-labeled Apur, by generally impaired ability to repair DNA damage, or by a direct effect of Apur on the endogeneous deoxynucleotide pools. The addition of 10 μM thymidine to the growth medium of AraC-6-1 cells lowered their high dCTP pool (two- to threefold), raised the TTP pool (two- to threefold), and abolished their enhanced mutability by Apur. Further manipulation to produce an abnormally high TTP/dCTP ratio suppressed Apur-induced mutagenesis (8- to 10-fold) in both AraC-6-1 and NSU-1 cells. These observations support the hypothesis that Apur induces A:T → G:C transitions in mammalian cells by a mispairing mechanism.

5503 Cytology

6508 (UCD—472-131, pp 66-69) **Bone histomorphometry: tissue preparation techniques.** Morrin, L.; Hood, S.J.; Park, N.J. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

The object of this report is to describe the materials and methods used to prepare the cortical bone samples studied in the authors laboratory. They have found that in many cases in the literature for editorial reasons or for space conservation reasons, the technical details are truncated. In developing their methods, they have compiled techniques from numerous private communications and relevant references. They feel that these details may be of value to others working in the field, and therefore a comprehensive discussion of these histomorphometric techniques is presented here.

6509 (UCD—472-131, pp 70-79) **Bone histomorphometry: analysis of results of juvenile cortical bone study.** Hood, S.J.; Morrin, L.A.; Parks, N.J.; Bugreeff, S.E. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

Six 1.5 year old beagles were labeled with three different fluorochromes at 2 week intervals. Characteristic areas and lengths were videoplanned and the histomorphometric parameters of absolute bond area, apposition rate, active surface, and volume based turnover calculated. This paper discusses the experimental results and data collection equipment setup details.

6510 (UCD—472-131, pp 92-104) **Partial differential equation model of the bone remodeling process: cell population dynamics in canine cortical bone.** Hood, S.J.; Parks, N.J.; Brewer, J.W. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

The bone remodeling process in canine cortical bone in the mid-shaft of the humerus is modeled with two forward Kolmogorov equations, convection-diffusion type partial differential equations, representing the osteoclast cells and the osteoblast precursor cells, respectively. The osteoblasts are modeled with an ordinary differential equation. The bone remodeling system was studied experimentally by injecting beagles with three different fluorochromes to mark new, calcifying bone. A Videoplan microcomputer was used to measure the histomorphometric parameters that describe the bone remodeling system. The mathematical solutions are in the form of probability densities. The steady-state solution to the osteoclast equation can be interpreted as the density function of the maximum diameters of the bone remodeling units. The predicted density is consistent with the experimental density. The solution to the osteoblast equation can be interpreted as the density of the fluorescent label sizes and the solution can also be used to calculate the rate at which new bone is added to the remodeling unit, the apposition rate. The predicted densities are consistent with the experimental densities.

5504 Genetics

REFER ALSO TO CITATION(S) 6544

6511 **(BNL—40245) Advantages and limitations of using Spm as a transposon tag.** Cone, K.C.; Schmidt, R.J.; Burr, B.; Burr, F.A. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 24p. (CONF-8708155—1). NTIS, PC A02. Order Number DE88001336/JAW.

From International symposium on plant transposable elements; Madison, WI, USA (22 Aug 1987).

Transposon tagging has become the method of choice for isolating genes whose products are in low abundance. We have recently used the transposable element Spm to tag and clone maize regulatory loci. Our choice of Spm was dictated by several factors: The frequency of transposition of Spm is high enough to obtain detectable transposition events, into loci affecting kernel traits, in populations of $<10^6$ seed. Although the copy number of Spm is high in the maize genome, insertions into the gene of interest can be distinguished from other Spm copies by digesting DNAs from segregating populations with methyl-sensitive restriction enzymes, and hybridizing with Spm-specific probes. Since all members of the Spm family thus far examined share DNA homology, hybridization with appropriate probes allows detection of insertions of both autonomous and defective elements. Thus, if a mutable allele can be shown to be under Spm control, one can be reasonably confident of successfully cloning that allele. 23 refs., 3 figs., 2 tabs.

6512 **(BNL—40331) Activation of silent transposable elements.** Burr, B.; Burr, F.A. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 13p. (CONF-8708155—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001558/JAW.

From International symposium on plant transposable elements; Madison, WI, USA (22 Aug 1987).

It is well known among maize geneticists that agents that cause chromosome breakage can activate quiescent transposable elements. However, other than temporarily relieving position effect, it is difficult to understand how these events can lead directly to activation. One possibility is that chromosome breakage can initiate a process in the cell resulting in a higher rate of spontaneous mutation. Such a system could be analogous to the SOS response of Escherichia coli, in which an error-prone repair system is induced. Chemical mutagens that cause little chromosome breakage, but add bulky adducts to the DNA can induce the SOS response. In seed homozygous for a1-m2(8004), wx-m8, no active Spm, that had been treated with ethyl methanesulfonate, we observed activation of Spm at the rate of 1.1×10^{-4}. The spontaneous rate of activation in this material was 1.2×10^{-5}. Most of the activation events occurred as single kernels. This result contrasts with sectors covering at least 1/8 of the ear that would have been expected if activation had occurred as a direct result of mutagenesis in the mature kernel. The late timing of these events suggests that the activation, in most instances, may not be the direct result of chemical mutagenesis. 41 refs.

6513 **Model involving gene inactivation in the generation of autosomal recessive mutants in mammalian cells in culture.** Simon, A.E.; Taylor, M.W.; Bradley, W.E.C.; Thompson, L.H. (Program in Genetics, Dept. of Biology, Indiana Univ., Bloomington, IN 47405). *Molecular and Cellular Biology;* 2: No. 9, 1126-1133(Sep 1982).

The authors present evidence for a two-step model for expression of the recessive phenotype at the diploid adenine phosphoribosyltransferase (aprt) locus in Chinese hamster ovary cells. This model proposes a high-frequency event leading to allelic inactivation and a low-frequency event leading to a structural alteration of the APRT protein. Either event can occur first, resulting in two types of heterozygous cells. The proposed model is based on analysis of Chinese hamster ovary presumptive aprt heterozygotes and APRT/sup -/ mutants, derived by two different laboratories. The major class of heterozygotes (class 1) had approximately 50% parental APRT activity, 50% immunologically precipitable APRT protein, and only wild-type enzyme as based on two-dimensional gel electrophoresis and thermal inactivation studies. The authors propose that one allele at the aprt locus has been inactivated in these heterozygotes. APRT/sup -/ mutants derived from any single class 1 heterozygote arose at a low frequency and contained either no immunologically detectable APRT protein or an APRT enzyme which was, in most cases, demonstrably altered. The second class of heterozygotes, consisting of two independent isolates, gave rise to APRT/sup -/ cells at a high frequency (10/sup -3/ to 10/sup -5/). These heterozygous cell lines had 50% of parental APRT activity and only wild-type spot, or wild-type and an electrophoretic variant spot, on two-dimensional gels. These aprt heterozygotes appear to have arisen by mutation at one allele. APRT/sup -/ mutants derived from either heterozygote of this class had all lost the wild-type activity, consistent with the proposed model.

5505 Metabolism

REFER ALSO TO CITATION(S) 6550

5506 Medicine

REFER ALSO TO CITATION(S) 6210, 6540

6514 **(DOE/ER/60238—1) Automated radiopharmaceutical production systems for positron imaging.** Brownell, G.L.; Kairento, A.L.; Kizuka, H.; Kehayias, J. (Massachusetts Inst. of Tech., Cambridge (USA); Brookhaven National Lab., Upton, NY (USA)). 20 Aug 1987. Contract FG02-84ER60238. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000907/JAW.

This study provides information that will lead towards the widespread availability of systems for routine production of positron emitting isotopes and radiopharmaceuticals in a medical setting. The first part describes the collection, evaluation, and preparation in convenient form of the pertinent physical, engineering, and chemical data related to reaction yields and isotope production. The emphasis is on the production of the four short-lived isotopes C-11, N-13, O-15 and F-18. The second part is an assessment of radiation sources including cyclotrons, linear accelerators, and other more exotic devices. Various aspects of instrumentation including ease of installation, cost, and shielding are included. The third part of the study reviews the preparation of precursors and radiopharmaceuticals by automated chemical systems. 182 refs., 3 figs., 15 tabs.

6515 **(INIS-mf—11061) /sup 131/I-NaI gelatin capsules in diagnostics and therapy.** Schuerer, M. (Isocommerz G.m.b.H., Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). [1987]. 4p. (In English, German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700773/JAW.

The use of radionuclides in diagnostics and therapy of the thyroid are discussed in general as well as with special regard to radiation exposure. The advantages of the application of /sup 131/ I-NaI gelatin capsules for thyroid diagnosis and therapy, resp., are pointed out above all as to problems of radiation protection.

6516 (UCD—472-131, pp 80-81) **Film holder for microradiography of large undecalcified bone specimens.** Miyabayashi, T.; Ballard, D. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

A film holder was constructed for microradiography of large ground sections of bone specimens, which were embedded in methyl methacrylate. A vacuum system was used to assure close contact between the specimen and microradiographic film. A table top, low energy x-ray unit was used as an x-ray source. With this method, satisfactory microradiographs could be produced. This holder was easy to make and should be considered by those who are involved in large specimen microradiography.

6517 (UCD—472-131, pp 82-84) **Contact microradiography of large undecalcified bone specimens: a technique.** Miyabayashi, T. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

In a long-term toxicological study of the effects of ^{226}Ra and ^{90}Sr, microradiographic evaluation of bone tissues is useful. A microradiographic unit was custom-made to satisfy this purpose. However, the unit could not accommodate larger specimens such as the vertebrae in which neoplasia was seen due to the effect of the radionuclides. Due to this limitation, another method to produce a large specimen microradiogram was devised. A contact microradiographic technique for large undecalcified bone specimen is described.

6518 (UCD—472-131, pp 85-89) **Microangiographic study of the canine dental tissues: a preliminary report.** Miyabayashi, T.; Morgan, J.P. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

A microangiographic study of the dental tissues was performed on one adult mongrel dog to examine the usefulness of the technique. This preliminary study used 30% wt/vol Micropaque suspension which was perfused into the common carotid arteries. After the complete perfusion, the specimen was fixed into a mixture of 10% buffered neutral formalin solution and 95% ethyl alcohol. The mandibular bone with teeth in situ was decalcified. The specimen was embedded in methyl methacrylate. One mm slab sections were made, and then the microangiographs were made. Adequate filling of arterioles was evident on the microangiographs. This technique is shown to be useful in characterizing the nature of the blood supply to the bone and teeth that might be involved in the pathogenesis of radiation-induced injury in the canine dental and periodontal tissues.

5507 Microbiology

REFER ALSO TO CITATION(S) 6410, 6411

5510 Physiological Systems

REFER ALSO TO CITATION(S) 5576, 6536

5520 Public Health

REFER ALSO TO CITATION(S) 5864, 6432, 6441, 6442, 6443, 6444, 6445, 6446, 6447, 6448, 6449, 6556, 6557, 6560, 6561

6519 **(CONF-871075—13) Space-time clusters of adverse health events as a means of early detection of departure from planned containment.** Aldrich, T.E.; Easterly, C.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001439/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Studies of rare health events offer a novel means for assessing community health impacts from excursions of hazardous contaminants into the ambient environment. Clusters of these infrequent, adverse health occurrences provide sentinel phenomena to epidemiologists for the purpose of formulating preventive strategies and decision rules. The goal of early identification and interpretation of these case clusters has led to the development of a variety of statistical methods. This presentation provides an overview of these techniques, many of which assume infectious disease processes that may reasonably be translated as a common source exposure. Population-based disease registries are substantial sources of data for conducting studies of small area case clusters near contaminated waste sites. The strategy of population surveillance has found initial acceptance as a means of directing environmental health actions and providing a safeguard for public health. The methods discussed are possible choices for analyses directed to cancer or birth defect data in order to identify possible case clusters of rare events. Suggestions are offered for interpreting case clusters of disease and a model, semiquantitative decision process is proposed for use in determining public health action or policy. 26 refs., 1 fig., 1 tab.

6520 **(INIS-mf—10735) Report on second FAO/IAEA research coordination meeting on radiotracer studies of fungicide residues in food plants - Neuherberg, Germany, F.R., 4-8 May 1987. Draft.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). 1987. 18p. (CONF-8705211—Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750552/JAW.

From 2. FAO/IAEA research coordination meeting on radiotracer studies of fungicide residues in food plants; Neuherberg, F.R. Germany (4 May 1987).

In 1984, the FAO/IAEA Joint Division established the coordinated research programme on 'Radiotracer studies of fungicide residues in food plants'. The first FAO/IAEA research coordination meeting of the programme was held in Panama City, Panama in October 1985. It established a framework for experiments by the participating researchers to investigate metabolism and terminal residues of ethylenebisdithiocarbamates in food plants using /sup 14/ C-labelled materials with associated and other techniques. In this second report, progress made since the first report is presented and the further research needed to fulfill the objectives of the programme is outlined. The objectives of the meeting were as follows: To review progress within the coordinated research programme; To discuss problems pertinent to methodologies and labelled substrates; To prepare a report and recommendations with particular reference to future needs and priorities. The 12 papers presented at the meeting are given in summary form.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 5579, 5580, 6455

6521 (DOE/CH/10288—6) Radiation induced changes in the cuticular hydrocarbons of the granary weevil and their relationships to desiccation and adult mortality: Half yearly report, February 16 to August 15, 1987. Sriharan, S. (Selma Univ., AL (USA). Div. of Natural and Applied Sciences). 1987. Contract FG02-86CH10288. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001543/JAW.

This report outlines studies on the rate of moisture-loss in irradiated weevils and correlation loss of water with mortality. Further changes in the cuticular hydrocarbons of weevils as a result of gamma radiation were determined. 2 figs., 10 tabs.

6522 (IAEA-R—3098-F) Disinfestation of copra, desiccated coconut and coffee beans by gamma radiation. Final report for the period 1 May 1982 - 31 January 1986. Manato, E.C. (Philippine Atomic Energy Commission, Diliman, Quezon City). (International Atomic Energy Agency, Vienna (Austria)). Aug 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700604/JAW.

Nine insect pests were found associated with copra of which copra beetle, Necrobia rufipes, saw-toothed grain beetle, Oryzaephilus surinamensis, red flour beetle, Tribolium castaneum, cigarette beetle, Lasioderma serricorne and tropical warehouse moth, Ephestia cautella were found feeding on this food. While feeding on different coffee beans, coffee bean weevil, Araecerus fasciculatus De Geer showed preference on Arabica, Liberica and Excelsa but not in Robusta coffee beans. For mass rearing, the most suitable medium for copra beetle was desiccated coconut + yeast (2:1) and for coffee bean beetle, it was dried cassava chips + yeast (3:1). The life cycles completed in these food media were 43 to 60 and 42 to 56 days by copra beetle and coffee bean weevil respectively. Irradiation studies on these 2 species of insects showed that the eggs were most sensitive followed by larvae and pupae. A dose of 0.05 kGy prevented adult emergence from irradiated eggs and younger larvae, while doses of 0.10 to 0.25 kGy effected the survival of emerged adults. However, a dose of 0.50 kGy would be effective for the disinfestation of small packages (i.e. 0.25 to 0.50 kg in each) of copra or coffee beans initially infested with immature stages of beetles and weevils respectively. Packaging of irradiated commodities in polypropylene bags particularly those impregnated with permethrin prevented reinfestation by the insect pests. Toxic residues of permethrin in the prolypropylene film resulted in high mortality thereby preventing insect penetration of the packaging materials. Both copra beetles and coffee bean weevils were rather good invaders than penetrators as these species entered into the packages readily through existing openings in jute sack, woven polypropylene sack or flour bag. Organoleptic tests showed no change in aroma, flavour and general acceptability of irradiated coffee beans. Refs, figs and tabs. (Abstract Truncated)

6523 (IAEA-R—3590-F) Mutation breeding in Philippine fruits. Final report for the period 1 December 1982 - 28 February 1987. Espino, R.R.C. (University of the Philippines at Los Banos, Laguna. College of Agriculture). (International Atomic Energy Agency, Vienna (Austria)). Sep 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700606/JAW.

Studies were made to establish standard conditions for mutation induction by gamma-irradiation to be performed in combination with in-vitro culture for banana and citrus spp. Besides this, radio-sensitivity of seeds and/or plantlets of mango, sugar apple, soursop, lanzones and Jack fruit was investigated and primary observation on the occurrence of mutation was made. For the mutagenesis of banana shoot tip cultures, radio-sensitivity of plantlets derived from the culture as well as fresh-cultured shoots was examined and phenotypes indicative of mutation, such as chlorophyl streaking, slow growth, pigmentation and varied bunch orientation were recorded. Isozyme analysis for mutated protein structure was not conclusive. In the in-vitro culture of Citrus spp., seeds placed on fresh media as well as germinating seeds and two-leaf stage seedlings in test tubes were examined for their radio-sensitivity. Irradiated materials were propagated for further observation. In these two crops, basic methodology for mutation induction with combined use of in-vitro culture and gamma-irradiation was established. In mango, sugar apple, soursop, lanzones and Jack fruit, basic data on radiosensitivity were obtained. In mango, leaf abnormalities were observed after the treatment of scions. 6 refs, 10 figs, 14 tabs.

6524 (SSI—86-26) Strontium-90 content in the reindeer meat, 1965-1975, 1979-1980. Gudowska, I.; Oestergren, I. (National Inst. of Radiation Protection, Stockholm (Sweden)). 27 Oct 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750362/JAW.

The content of strontium-90 in reindeer meat is presented. The meat samples were taken from the autumn and winter slaughters in the northern part of Sweden after the fallout from the nuclear tests during the 1960s and 1970s. The strontium activity measurements were performed using a chemical analysis. The content of cesium-137 and the Sr/Cs activity ratio for the reindeer meat samples is also presented and the Sr/Ca ratio is discussed. (Authors).

6525 (SSI—86-29) Uptake of Cs 137 from farmland 1986-1989. Holmberg, M. (National Inst. of Radiation Protection, Stockholm (Sweden)). Dec 1986. 23p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750363/JAW.

The basic mechanisms of the accumulation of Cs 137 in grass, corn, oleiferous plants, potatoes etc are described. It is also presented as a function of time after the deposition. Transport of Cs 137 to milk, meat and bacon is described. A prognosis of Cs 137 in food products for the coming two years is made on basis of the estimated data. (G.B.).

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 6532

6526 (CONF-871075—4) Preparing the radiation protection worker to meet multiple needs. Abercrombie, J.S.; Thorpe, B.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000587/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

At the Oak Ridge National Laboratory (ORNL) the radiation protection worker aids in protecting personnel and their surrounding environment from the hazards of radiation. These individuals use their technical knowledge, skills, and abilities to survey and monitor various project-related activities. They must also provide guidance in project design, development, and implementation. These combined efforts assure that protective measures are taken in accordance with applicable standards. The ORNL performance-based training program enhances the skills of the worker. The program incorporates job specific information on the diverse facilities and activities monitored with basic fundamentals of radiation protection. Successful completion of this program includes passing both a qualification exam and an on-the-job skills review. This paper details the structure of such a program and explains the strategies taken to reach the program's goals. 4 refs., 2 tabs.

6527 (ENEA-RT-PAS—87-6) Dynamical model predicting the transport of I-131 through the deposition pasture cow milk pathway. Monte, L. (ENEA, Casaccia, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700762/JAW.

A dynamical model predicting the transport of I-131 through the atmospherical deposition-pasture-cow-milk pathway has been developed and validated using data collected in a specific site (a little farm in Anguillara - Rome) during the Chernobyl accident. The main factor affecting the uncertainty of the results of the model are discussed.

6528 **(INIS-mf—10741) Influence of actinomycin D on the recovery from sublethal irradiation of human cells in vitro.** Baur, J. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 18 Jul 1985. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751015/JAW.

In this work it was investigated to see if Actinomycin D would have an irradiation-sensitizing effect on healthy human cells. As well, the question was dealt with of whether Act D was in a position to hinder the repair of the cumulative sublethal and potentially lethal irradiation damage of the cell. For the experiment healthy human cells of the renal tubule epithelium were used in the cell culture. By the application of Act D before a one-time irradiation a definite sensitization of the cells to gamma radiation can be observed. The width of the curve of a dose-response curve becomes narrower by 18% and the curve becomes 26% steeper. By fractionation of the radiation dose this effect can become even more pronounced. The repair of sublethal damage in HAK cells is not restricted. As many cells survived a cytostatic application befor a fractionated irradiation as did survive an application during the fractionating interval (repair phase).

6529 **(INIS-mf—10743) Ultrastructural inquiries of the effects of X-radiation on melanocytes in monolayer cultures.** Hotzel, C. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 30 Nov 1984. 59p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751017/JAW.

Melanocytes (HPM-73 cells) in monolayer culture, which in the exponential growth phase were irradiated with an X-ray dose of 8 Gy (800 rad) and 16 Gy (1600 rad), showed ultrastructural changes in the cell wall (for example, microvilli), in elements of the cytoskeleton (microtubules and microfilaments), of the mitochondria and a change in structures containing melanin (melanosomes/pre-melanosomes). As a control, melanocytes incubated in a culture medium containing serum were used. The irradiated cells showed morphologically tangible cell changes. It resulted in a strong development of the cytoskeleton (microtubules and microfilaments), an increase in lysosome-like structures, a re-orientation of cell wall structures in the form of a reduction of wall extensions (decrease in size of microvilli) and an increase in structures containing melanin. It was also noticed that the cells which had received 16 Gy (1600 rad) were damaged more than the cells which had received 8 Gy (800 rad), whereby the more highly irradiated cells still were not understood to be in 'disintegration'. All of these changes should be considered under the aspect of repair mechanisms after cell damage (irradiation). Altogether melanocytes are in comparison to other tumor cells less radiation sensitive.

6530 **(INIS-mf—10744) Radiation exposure by Tc-99m-methyldiphosphonate - development and use of a biophysical model for the determination of the local dose distribution in growth zones of a child's skeleton.** Petrausch, G. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Physik). 26 Jun 1984. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751018/JAW.

For the determination of the data necessary for dose calculations of an intraveneous application of Tc-99m-MDP in children, ages 3 months to 7 years, test data for the biokinetics of MDP in the whole body as well as in body areas with and without radioactive concentrations was determined by the use of a whole body activity counter and a gamma camera. These investigations were supplemented by laboratory data on the radioactive decay of Tc-99m-MDP in blood serum and on the urinary excretion of MDP. For the determination of the target volume of epiphyseal growth areas with radioactive concentrations distortion corrected measurements of the patient from the bone scintographs were compared to the biological data taken from our X-ray images. The radiation exposure of these growth areas was calculated with consideration of results from animal investigations as well as under the assumption that larger target volumes could be present in the patients. In the animal investigations the organ distribution of the MDP at various times after application, along with the biokinetic data of MDP in the whole body was ascertained as well as the distribution along long hollow bones. The calcium distribution was activationally analytically ascertained along long hollow bones in a young and an adult dog. It was attempted in the animal investigations to autoradiographically present the microdistribution of MDP in border regions epiphyseal cartilage/epiphyseal center and epiphyseal cartilage/metaphyseal growth plate.

6531 **(INIS-mf—10745) /sup 60/Co-γ-irradiation of dried DNA and isolated cell nuclei of chicken erythrocytes.** Kroenke, I. (Bochum Univ. (Germany, F.R.). Abt. fuer Chemie). 10 Feb 1983. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751019/JAW.

Schriftenreihe des Max-Planck-Instituts fuer Strahlenchemie.; no. 7.

In this work low molecular products, which resulted from γ-irradiation of dried DNA, were isolated and quantitatively determined. Unchanged nucleic bases were released. The irradiation was successful in a vacuum as well as in oxygen. In the case of the drily irradiated DNA, the base release made up 30% of the total strand breaks. The release of DNA bases was also first studied in cell nuclei of eucaryotic cells, the erythrocyte nuclei of chicken blood. The second part of this work dealt with the isolation and identification of radiation induced changes in the 2-dioxyribose unit of DNA. In the third part it was investigated, whether as a result of γ-irradiation of DNA malonic dialdehyde was formed. It could be shown that neither malonic aldehyde nor basic propenal were formed, but instead products, which were still bound to the DNA and formed a chromophore with 2-thio barbituric acid. In this work the direct irradiation effect was investigated in DNA systems as well as in erythrocyte nuclei. By the isolation of low molecular irradiation products this work offers a contribution to the understanding of the irradiation chemistry in an eucaryotic cell, in which the direct effect on the DNA and the resulting radiation damage were given a deciding role for genetic information.

6532 **(INIS-mf—10746) Investigations on radiation damage of DNA from γ-irradiated Escherichia coli B/r.** Geldermann, H.H. (Bochum Univ. (Germany, F.R.). Abt. fuer Chemie). 10 Feb 1983. 155p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751020/JAW.

Schriftenreihe des Max-Planck-Instituts fuer Strahlenchemie.; no. 6.

For the study of radiation damage in the DNA of Escherichia coli (E. coli) B/r it was worthwhile to begin with to investigate simple model systems. By adaptation of these model systems to the chemical relationships inside the cell conclusione on the radiochemical changes in the DNA of E. coli B/r can be drawn. When nucleic acids are irradiated bases are split off. Since bacteria cells contain much higher concentrations of DNA and since they were irradiated at 0degC, the model systems had to be adjusted to the conditions. With the irradiation of aqueous nucleic acid solutions in the presence of OH-radical receptors the splitting of nucleobases and the formation of changed sugars was decreased. This effect is primarily due to the competition of the OH-radicals. With the irradiation of RNA in an oxygen-free N/sub 2/O-saturated aqueous solution not only ribose but also a variety of changed sugars were found which were linked in the RNA chain by phosphoric acid diester groups. With the irradiation of E. coli the formation of changed sugars and the splitting off of nucleobases was observed. The study of concentrated DNA solutions in the presence of radical receptors gives results which allow themselves to be used with bacteria cells. This model system appears to be suited for simulating radiolytic changes in the DNA of cells.

6533 **(LBL—23809) Reaction analogues in the radiation-induced deamination and dephosphorylation of bio-organic molecules: oxygen-free systems.** Garrison, W.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000651/JAW.

The reductive deamination of α-amino acids and peptides by e/sub aq/$^-$ and the oxidative dephosphorylation of glycol phosphates by OH are shown to be related in terms of a common elimination reaction involving free-radical intermediates of the same genre. A comparison is made of main-chain cleavage and HX elimi-

nation in the radiolysis of histone and of DNA in oxygen-free solution. 26 refs.

6534 **(ORNL/TM—10080) Age-specific models for evaluating dose and risk from internal exposures to radionuclides: Report of current work of the Metabolism and Dosimetry Research Group, July 1, 1985-June 30, 1987.** Leggett, R.W.; Warren, B.P. (eds.). (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001528/JAW.

A projection of the health risk to a population internally exposed to a radionuclide requires explicit or implicit use of demographic, biokinetic, dosimetric, and dose-response models. Exposure guidelines have been based on models for a reference adult with a fixed life span. In this report, we describe recent efforts to develop a comprehensive methodology for estimation of radiogenic risk to individuals and to heterogeneous populations. Emphasis is on age-dependent biokinetics and dosimetry for internal emitters, but consideration also is given to conversion of age-specific doses to estimates of risk using realistic, site-specific demographic models and best available age-specific dose-response functions. We discuss how the methods described here may also improve estimates for the reference adult usually considered in radiation protection. 159 refs.

6535 **(OUP—87-19) On short-distance CP-violating contributions to the K/sub L,S/->γγ processes.** Eeg, J.O.; Picek, I. (Oslo Univ. (Norway). Fysisk Inst.). Jul 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750351/JAW.

New short-distance penguin-induced quark diagrams for K/sup o/ anti (K/sup o/) -> γγ within the standard model are considered. These diagrams leave the total CP-conserving amplitude essentially unchanged. However, the CP-violating amplitude receives a sizeable contribution comparable with the pole contribution, which has so far been considered to be the only contribution including direct CP-violation.

6536 **(PNL-SA—13583) Report of international workshop on gastrointestinal absorption of actinides and other metals.** (Pacific Northwest Lab., Richland, WA (USA)). Jan 1986. Contract AC06-76RL01830. 39p. (CONF-8506370—Summ.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000550/JAW.

From International workshop on gastrointestinal absorption of actinides and other metals; Seattle, WA, USA (24 Jun 1985).

Current knowledge of the fraction of ingested actinide absorbed from the gastrointestinal (GI) tract, and of factors influencing that fraction absorbed, is probably adequate for the establishment of safe limits for the exposure of workers. Uncertainties necessitate a degree of probable overprotection that is often costly. Our knowledge of factors that may influence actinide absorption by members of the more heterogeneous general population is in a less satisfactory state, particularly with regard to the infant and to other groups with dietary habits or medical treatment regimens that differ from the norm. Further investigation in several research areas is required to support more realistic occupational limits and to evaluate and regulate the exposure of general populations. This report includes summaries of various topics. Among these topics are limited studies of actinide absorption in human volunteers that would provide the critical data needed for intelligent extrapolation of results from past and future studies with experimental animals; studies to further our understanding of the basic physiological mechanisms involved in the transport of actinides into, and across, the intestinal epithelium; and studies with experimental animals in preparation for studies with human volunteers.

6537 **(PNL-SA—14773) Population exposures from US Department of Energy operations.** Welty, C.G. Jr.; Kennedy, W.E. Jr.; Hawley, K.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 11p. (CONF-8709104—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001903/JAW.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

The DOE annually collects information concerning emissions and calculates radiation doses to the population within an 80-kilometer radius of its operating nuclear installations. For most of these installations, the resulting concentrations in environmental media are too low to be adequately measured; at those sites, computer modeling is used to predict values for estimating public radiation doses. The estimated public doses are evaluated by the DOE to ensure that its operations are in compliance with its public radiation dose standards. This paper describes the calculated population dose from all operating DOE installations for recent years, including radionuclide-specific contributions to public dose and comparisons with the expected population dose resulting from all background sources of radiation. The year-to-year trends since 1979 are shown, together with a description of the major reasons for the trends. Of significance to the dose estimation for this period was the change to using the effective-dose-equivalent factors. We conclude that the estimated radiation doses of combined DOE operations are small compared to the radiation dose received each year by the same population from natural sources of radioactivity. 5 refs., 4 figs., 2 tabs.

6538 **(PNL-SA—15132) Potential exposures from uranium enrichment.** Kennedy, W.E. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 11p. (CONF-8709104—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002135/JAW.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

Public radiation doses resulting from gaseous diffusion enrichment facility effluents can be assessed by considering the potential environmental exposure pathways. These exposure pathways result from releases to both air and water, and rely on model evaluations to predict environmental transport. For most airborne releases, inhalation is the primary exposure pathway. Secondary pathways, including external exposure during plume passage, ingestion of uranium deposited on or contained in vegetation, and external exposure to uranium deposited on land surfaces also contribute. For liquid effluents, the primary exposure pathway is ingestion of drinking water, with secondary contributions to dose from ingestion of aquatic biota and ingestion of irrigated vegetation. This paper reviews the important considerations for conducting collective dose assessments for gaseous diffusion enrichment facility operations, including a discussion of the dosimetric considerations for uranium and a summary of estimated collective doses resulting from gaseous diffusion enrichment in the United States. 11 refs., 2 figs., 4 tabs.

6539 (UCD—472-131, pp 2-7) **Strontium-90 and radium-226 toxicity in Beagle dogs: current status.** Goldman, M.; Culbertson, M.R.; Rosenblatt, L.S.; Parks, N.J.; Spangler, W.L. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

The authors are investigating biologic effects of ^{90}Sr and ^{226}Ra in the beagle in order to predict the possible long-term hazards to people from chronic exposure to low levels of irradiation. Animals received either radionuclide by several means of administration: (a) continual ingestion of ^{90}Sr, (b) a single intravenous injection of ^{90}Sr, or (c) a series of eight intravenous injections of ^{226}Ra. Although administration of ^{90}Sr and ^{226}Ra ended at 540 days of age, the animals throughout life continued to receive chronic, low-level radiation doses from these bone-seeking radionuclides. The significance of these long-term exposures given at low dose rates continues to be investigated with regard to cancer production, physiologic well-being, and shortening of life. 3 references, 3 figures, 4 tables.

6540 (UCD—472-131, pp 45-50) **Radium-226-induced dental disease in Beagles: a radiographic study.** Morgan, J.P.; Miyabayashi, T.; Goldman, M.; Soo, S. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

Evaluation of dental radiographs made at necropsy and during the life of the dogs clearly shows age dependent changes within the control dogs. Periodontal diseases, loss of lamina dura, root ankylosis, and loss of pulp cavity were all commonly noted. Tooth loss and dental caries were rare in the control dogs. In in-

jected Beagles loss of lamina dura was noted earlier and was dose dependent. Tooth loss and dental carried increased with dose level and appeared earlier. Tooth loss was common by 1600-1800 days of age while dental caries were common in almost all dogs by 1600-1800 days of age in the R40 level. Dental caries was the most accurate indication of the level of ^{226}Ra toxicity. 18 reference, 1 table.

6541 (UCD—472-131, pp 52-63) **Radiation leukemogenesis.** Kawakami, T.G.; Cain, G.; Taylor, N.; Foster, B. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

Dogs that are exposed to 4.4 or 11 R/day (4 or 10 cGy/day) of gamma-radiation beginning at 21 days of gestation continue to have a high incidence of myeloid leukemia after a short latent period. Radiation-induced myeloid leukemia is a complex myeloproliferative disease that involves different hematopoietic progenitor cells with variable clinical expression. A difference between aleukemia and acute myeloid leukemia in dogs may involve the quantitative difference in the levels of either growth stimulating and/or maturation arrest factors produced by the leukemic cells. Using a molecular hybridization technique in conjunction with known oncogene probes and restriction endonucleases, the authors detected neither rearrangement of known proto-oncogene by the Southern blot technique nor amplification of known proto-oncogene expression by the RNA dot blot technique. Canine myeloid leukemic cell lines have been established from dogs with monocytic and myelomonocytic leukemia. These cell lines have been partially characterized and have been transplanted into irradiated newborn puppies. These leukemic cells produce a growth factor that appears to depend on whether the cells are of monocytic or myelomonocytic progenitor cell. The monocytic leukemic cell produces a colony stimulating factor for normal granulocytes-monocytes while the myelomonocytic leukemic cell produces a growth stimulating factor for myelomonocytic leukemic cells. 9 figures, 4 tables.

6542 (UCD—472-131, pp 105-107) **Radioresistant canine hematopoietic cells.** Kawakami, T.G.; Shimizu, J.; Rosenblatt, L.S.; Goldman, M. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

Survival of dogs that are continuously exposed to a moderate dose-rate of gamma radiation (10 cGy/day) is dependent on the age of the dog at the time of exposure. Most dogs exposed postpartum to gamma radiation suffered from suppressed hematopoiesis and died of aplasia. On the other hand, none of the in utero-exposed dogs suffered from suppressed hematopoiesis and most became long-term survivors, tolerating 10-fold greater total dose, but dying of myeloproliferative disease (MPD). Using acute gamma irradiation of hematopoietic cells and colony forming unit cell assay (CFU), they observed that a canine hematopoietic cell line established from a myeloid leukemic dog that was a long-term survivor of continuous irradiation was approximately 4-fold more radioresistant than a hematopoietic cell line established from a dog with non-radiation-induced myeloid leukemia or hematopoietic cells from normal canine bone marrow. In utero dogs that are long-term survivors of continuous irradiation have radioresistant hematopoietic cells, and radioresistance that is a constitutive property of the cells.

6543 (UCD—472-131, pp 110-122) **Data inversion methods for aerosol size measurements.** Zhu, Z.; Raabe, O.G. Jun 1987. NTIS, PC A07/MF A01. Order Number DE87013978/JAW.

In Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.

The aerosol data inversion problem can be modeled by the Fredholm Integral Equation of the First Kind (FIEFK), but it is ill posed. There are no methods available at the present time that can perfectly fulfill the task of providing the unknown size distribution. Existing methods are reviewed. Three methods were chosen for comparison of their suitability to the data inversion problem encountered in the aerosol science: (a) the Twomey nonlinear iteration inversion, (b) the Crump and Seinfeld generalized cross validation method, and (c) the Raabe nonlinear least-square fitting method. Numerical and experimental tests were carried out for the three methods using (unimodal) log normal aerosol size unimodal distributions with several size measuring devices: collimated hole diffusion battery (CHDB), screen type diffusion battery (STDB), electrical aerosol analyzer (EAA), Cascade impactor, parallel diffusion battery (PDB), and electrostatic aerosol sampler (EAS). It was found that the Crump and Seinfeld Method No. 2 was superior to the widely used Twomey method, but the Raabe nonlinear least square method was the best method for the unimodal distributions in this study.

6544 (UCRL—97276) **Analytical cytology applied to detection of induced cytogenetic abnormalities.** Gray, J.W.; Lucas, J.; Straume, T.; Pinkel, D. (Lawrence Livermore National Lab., CA (USA)). 6 Aug 1987. Contract W-7405-ENG-48. 8p. (CONF-870701—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000785/JAW.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

Radiation-induced biological damage results in formation of a broad spectrum of cytogenetic changes such as translocations, dicentrics, ring chromosomes, and acentric fragments. A battery of analytical cytologic techniques are now emerging that promise to significantly improve the precision and ease with which these radiation induced cytogenetic changes can be quantified. This report summarizes techniques to facilitate analysis of the frequency of occurrence of structural and numerical aberrations in control and irradiated human cells. 14 refs., 2 figs.

5602 Thermal Effects

6545 (DOE/EV/10259—5-Vol.1) **Geographic analysis of thermal equilibria: A bioenergetic model for predicting thermal response of aquatic insect communities: Volume 1: Technical progress report, February 1, 1985-January 31, 1988.** Vannote, R.L.; Sweeney, B.W. (Academy of Natural Sciences, Avondale, PA (USA). Stroud Water Research Center). 1987. Contract AC02-79EV10259. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000638/JAW.

This report summarizes the principal research findings of both laboratory and field experiments on the effects of temperature on aquatic insects. It describes a large-scale laboratory experiment that tests the validity of a general model developed to predict the seasonal pattern of growth, development, and adult emergence of aquatic insect species at different locations in their geographic range. The report details the transition of the research program from its present focus on the ecology of stream and river insect populations to a program emphasizing the role of riparian biotic and geochemical factors in regulating the dynamics of stream systems. The long-term goals are to develop the functional relationships between alluvial floodplains and its drainage network. Initially, research will focus on mechanisms regulating input storage, transformation and release of nutrients between the riparian system and streams. Volume 1 reports on field studies of natural and thermally modified river systems, as well as laboratory studies on electrophoretic analysis of insects. 12 refs., 17 figs., 2 tabs.

6546 (DOE/EV/10259—5-Vol.2) **Geographic analysis of thermal equilibria: A bioenergetic model for predicting thermal response of aquatic insect communities: Volume 2: Technical progress report, February 1, 1985-January 31, 1988.** Vannote, R.L.; Sweeney, B.W. (Academy of Natural Sciences, Avondale, PA (USA). Stroud Water Research Center). 1987. Contract AC02-79EV10259. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001402/JAW.

This report summarizes the principal research findings of both laboratory and field experiments on the effects of temperature on aquatic insects. It describes a large-scale laboratory experiment that tests the validity of a general model developed to predict the seasonal pattern of growth, development, and adult emergence of aquatic insect species at different locations in their geographic range. The report details the transition of the research program from its present focus on the ecology of stream and river insect populations to a program emphasizing the role of riparian biotic

and geochemical factors in regulating the dynamics of stream systems. The long term goals are to develop the functional relationships between alluvial floodplains and its drainage network. Initially, research will focus on mechanisms regulating input storage, transformation and release of nutrients between the riparian system and streams. Volume 2 contains studies on the effects of temperature and food quality on the growth of larval insects as well as experiments on insect metabolism. 24 refs., 15 figs., 10 tabs.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 5421, 5462, 5955, 5972, 6418, 6442, 6444, 6447, 6448, 6449, 6456, 6487, 6507, 6512, 6536

6547 **(CONF-871075—17) Present and projected methods for assessing the hazard represented by complex mixtures.** Glass, L.R.; Easterly, C.E.; Jones, T.D. (Texas Univ., Houston (USA). School of Public Health; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001423/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Current methods for the toxicologic evaluation of complex mixture approaches the problem from the interaction of the individual chemicals constituting the mixture; complex mixtures produce health effects that can be additive, antagonistic, or synergistic relative to the components acting along. Most exposures are limited to mixtures. One option is to conceptually approach the complex mixture as a unique chemical. The evaluation of that mixture would proceed in a similar fashion to that of any empirical toxicologic analysis. Because the use of whole animal test systems for the analysis of every mixture would not be cost effective, this project develops a framework for the use of in vitro assays to assist in this type of evaluation. 12 refs., 3 tabs.

6548 **(CONF-871075—27) Rapid screening of hazard (RASH) based on maximum use of biological data and minimum use of extrapolation models.** Jones, T.D.; Glass, L.R.; Easterly, C.E.; Owen, B.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002301/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Traditional methods for evaluation of human health effects are based on identification of the toxic agent, selection of a toxicological study judged to be a suitable analogue for man, analysis of the experimental dose response, incorporation of safety factors, and scaling of the dose and response values to be predictive for humans exposed to untested pollutants or under untested conditions. This method of absolute decision making derives from expert committees and regulatory standards for protection of human health. This work will describe how new relative methods can be used to supplement absolute methods used by the Environmental Protection Agency (EPA) to set regulatory standards and performance guidelines. Relative decision making uses many potency comparisons between various biological tests and minimizes the use of mathematical models commonly used to extrapolate dose and response metrics from past experience to future concerns. 10 refs., 2 figs., 5 tabs.

6549 **(CONF-8707118—1) Carbon allocation as an indicator of pollutant impacts on forest trees.** McLaughlin, S.B. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014946/JAW.

From Workshop on woody plant growth in a changing chemical and physical environment; Vancouver, Canada (27 Jul 1987).

Detecting physiological responses of forest trees to ambient levels of atmospheric pollutants and evaluating those responses in terms of their importance to tree vigor and production potential represent significant challenges to forest ecophysiologists. The study of alterations in carbon economy of pollutant-stressed trees, including carbon assimilation, utilization, and storage patterns, represents one approach that may encompass levels of detection ranging from short-term mechanistic responses to longer term responses that integrate seasonal or multiyear effects. Collectively these processes have direct relevance for evaluating qualitative and quantitative changes in growth and physiological resilience of forest trees. Examples of utilization of measurements of photosynthesis, dark respiration, energy storage reserves, secondary metabolites associated with plant resistance to pathogens, dry-matter partitioning, and patterns of annual radial growth of forest trees are examined in relation to their utility in evaluating mechanisms and consequences of pollutant effects on forest physiology and growth. Additional emphasis on measurement and integration of carbon allocation processes of forest trees under chronic air pollution stress is needed. 66 refs., 2 figs.

6550 **(DOE/ER/60239—1) Symposium on polycyclic aromatic hydrocarbons and cancer: Final report.** (Chicago Univ., IL (USA). Ben May Lab. for Cancer Research). 4 Aug 1986. Contract FG02-84ER60239. 9p. (CONF-840805—Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000381/JAW.

From 188. meeting of the American Chemical Society; Philadelphia, PA, USA (26 Aug 1984).

This symposium was organized to present recent important advances in the chemistry and biology of carcinogenic polycyclic aromatic hydrocarbons (PAH); widespread environmental pollutants produced by the combustion of fossil fuels. Many PAHs are potent carcinogens in experimental animals and PAHs may be primary causative agents in a significant percentage of human cancers. A second major objective was to bring together oral presentations for publication in book form. Additional chapters from invited authors who were not included in the symposium helped to cover all topics relevant to the mechanism of PAH carcinogenesis.

6551 **(DOE/PC/62999—12) Exploratory research on mutagenic activity of coal-related materials: Final report for period September 29, 1983-June 1, 1987.** Warshawsky, D.; Schoeny, R.S. (Cincinnati Univ., OH (USA). Kettering Lab.). 1987. Contract AC22-83PC62999. 263p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE87014560/JAW.

The objective of this research has been to develop integrated methods of chemical and biological analyses for use in the evaluation of potential biohazards associated with coal conversion. Five vacuum bottom samples were obtained for testing: H-coal PDU Run 9; H-coal PDU Run 10; Wilsonville ITSL Run 242 (V1067); Lummus ITSL Run 3LCF9 (Lum Feed); Lummus ITSL (Lum Product). These samples were assayed and found to be mutagenic for Salmonella strains TA97 and TA98. PDU-9 was the most mutagenic coal-derived material. Organic solvent fractions of these materials were variably mutagenic. One material (Lum Feed) gas evidence of synergistic interactions among the fractional components in the standard reverse assay. Results of forward assays and tests of the Lum. Feed and Lum. Prod. materials were suggestive of both loss of mutagenicity in the fractionation process and of interactions among fraction components contributing to enhanced mutagenicity. Results of forward mutation assays of samples of Lummus Product and Lummus Feed contrasted with those obtained from reverse mutation assays. Data from assay of both materials gave indications of the likelihood of interaction among fractions contributing to increased mutagenicity. The ability of sample fractions to influence biological activities of individual compounds known to be associated with synthetic fuels was also studied. Benzo(a)pyrene (BaP), was tested in the presence of the hexane fraction of PDU-9 in a forward assay incorporating 1% S9 from PCB-treated rats. Data suggest that the hexane fraction decreases BaP mutagenicity by interference with its metabolism by S9. In other mutagenicity assays 2-aminoanthracene (2AA), was tested in the presence of the hexane fraction of PDU-9. Data show an enhanced mutagenic response as a result of mixing these two materials. 31 refs., 57 figs., 47 tabs.

6552 **(KFK-PEF—25) Development of a method for forest damage inventory using multispectral scanner data.** Hildebrandt, G.; Kadro, A.; Kuntz, S.; Kim, C. (Freiburg Univ., Germany, F.R.. Abt. fuer Luftbildmessung und -interpretation). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Mar 1987. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750996/JAW.

This paper presents an investigation of spectral reflection properties of forest vegetation, esp. in reference to the difference between healthy and damaged trees and stands. The investigation is based on the evaluation of multispectral scanner data in the spectral regions visual, near IR and middle IR of the electromagnetic spectrum. Data were collected from different flight altitudes. A computer aided classification for forest stand damage inventory is presented and discussed. With 35 figs., 52 refs..

6553 **(MST-LUFT-A—114) Environmental impact on ombrotrophic bogs in Northwestern Europe. Effects of acid rain and nitrogen pollution on raised bogs and blanket bogs of Northwest Europe and practical means of conservation.** Voigt, A.; Johnsen, I. (Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab.). Mar 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750390/JAW.

Along a gradient in atmospheric deposition of nitrogen and sulphur, 11 raised bogs (ombrotrophic mires) and 3 blanket bogs in Sweden, Denmark, Federal Republic of Germany, the Netherlands, United Kingdom (Wales) and Ireland were investigated for vegetation composition, content of nitrogen and sulphur in plants and peat, and plant accessible cations. The vegetation composition showed beginning changes, which could be related to air pollution, in the most affected bogs in Germany, Holland and partially also Denmark, The picture was blurred by the overlying effect of drainage. Nitrogen and sulphur content was significantly higher in peat moss plants (Sphagnum) from more polluted bogs, and a strong correlation to estimated ammounts of nitrogen and sulphur deposition, implying that peat mosses are good indicators for air pollution. Control of emission, raising of water level to bog surface, buffer zone with control on fertilization and forest around the bogs (lagg forest) are recommended as conservation measures. 60 refs.

6554 **(ORNL—6312) Water quality criteria for 2,4-dinitrotoluene and 2,6-dinitrotoluene: Final report.** Etnier, E.L. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88000985/JAW.

Based on the evidence of an increased incidence of hepatic carcinomas and hepatic neoplastic nodules in male rats, the recommended criteria to achieve a human health risk of 10^{-5}, 10^{-6}, or 10^{-7} for 2,4-dinitrotoluene are 1.7, 0.17, and 0.017 μg/L, respectively. It should be noted that the 2,4-DNT used in the bioassay from which the criteria were calculated was 98% pure, with the remaining 2% comprised of predominantly 2,6-DNT. The possible influence of 2,6-DNT on the results of this study should not be overlooked. Results from a tumor bioassay suggest that pure 2,4-DNT is not carcinogenic, but limitations of the study preclude a definitive statement regarding the carcinogenicity of 2,4-DNT. There are no studies available documenting the systemic toxicity of pure 2,4-DNT, and thus no acceptable daily intake can be calculated. The water quality criterion for 2,6-DNT is derived from the data showing an increased incidence of hepatic carcinomas in male Fischer 344 rats. It should be noted that exogenous factors in the diet can affect the carcinogenicity of the DNT isomers, enhancing the metabolism and hepatic covalent binding of 2,6-DNT in particular. However, 2,6-DNT is unquestionably a potent hepatocarcinogen, and criteria based on this study will give a conservative estimate of the acceptable cancer risk. The recommended criteria to achieve a risk of 10^{-5}, 10^{-6}, or 10^{-7} for 2,6-dinitrotoluene are 68.3, 6.8, and 0.68 ng/L, respectively. 158 refs., 2 figs., 23 tabs.

6555 **(ORNL—6336) Water quality criteria for white phosphorus: Final report.** Davidson, K.A.; Hovatter, P.S.; Sigmon, C.F. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88000645/JAW.

Data obtained from a review of the literature concerning the environmental fate and aquatic and mammalian toxicity of white phosphorus are presented to derive Water Quality Criteria for the protection of humans and aquatic organisms and their uses. Laboratory and field studies indicate that white phosphorus is quite toxic to aquatic organisms, with fish being more sensitive than macroinvertebrates. Bioaccumulation is rapid and extensive, with the greatest uptake in the liver and muscle of fish and the hepatopancreas of lobster; however, depuration occurs within 7 days postexposure. Other toxic effects to aquatic organisms include cardiovascular and histological changes. Field studies indicate that effluents containing white phosphorus adversely affect receiving aquatic systems by decreasing diversity and increasing mortality of select species. Acute exposure to white phosphorus causes similar effects in laboratory animals and humans. In the absence of medical treatment, the estimated minimal lethal dose of white phosphorus in humans is 100 mg (1.4 mg/kg). Following ingestion, organs damaged by white phosphorus are the gastrointestinal tract, liver, kidney, brain, and cardiovascular system. Chronic and subchronic exposure of laboratory animals to white phosphorus by oral or subcutaneous routes results in reduced growth, reduced survival at high does, increased survival at low doses, and bone pathology. Humans chronically exposed to white phosphorus in the occupational environment develop a specific lesion (different from that observed in laboratory animals) called phosphorus necrosis of the jawbone or "phossy jaw." 139 refs., 1 fig., 18 tabs.

6556 **(PB—87-220950/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on proposed permanent standard for certain carcinogens, by M. Key, M.D., September 14, 1973.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 14 Sep 1973. 167p. NTIS, PC A08/MF A01.

The report discusses six NIOSH-supported studies regarding the occupational dangers to coke-oven workers including a sevenfold increases in the risk of developing kidney cancer. The testimony also presents Hazard Reviews and calls for the inclusion of several chemical carcinogens in the standard. The reports on some of these substances contained epidemiological evidence of increased cancer risks for individuals exposed to these substances in an occupational setting. Other reports were included on the basis of animal studies which supported the strong probability that these chemicals were carcinogens for humans as well.

6557 **(PB—87-222626/XAB) NIOSH (National Institute for Occupational Safety and Health) to DOL (Department of Labor) on OSHA (Occupational Safety and Health Administration) proposed rule for occupational exposure to formaldehyde, by R. Lemen, May 5, 1986.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 5 May 1986. 19p. NTIS, PC A02/MF A01.

In view of animal studies indicating that formaldehyde was a carcinogen, the testimony provided evidence to support the position that exposure to formaldehyde be kept to the lowest feasible concentration possible. Significant excesses of squamous-cell carcinomas of the nasal cavity were found in both male and female Fischer-344-rats, in male hybrid-mice, and in male Sprague-Dawley-rats. Results of individual studies suggested a connection between formaldehyde exposure and the incidence of lung cancer, brain cancer, leukemia, and nasopharyngeal cancer. Evidence suggested that formaldehyde forms cross linking bonds between DNA and protein at concentrations of 6ppm and greater. Examination of workplace exposure data suggested that in most occupations formaldehyde exposures were below 0.5ppm concentration levels with only 10 percent being above 1ppm.

6558 **(PB—87-228557/XAB) Technical analysis of new methods and data regarding dichloromethane hazard assessments. External review draft.** Bayard, S.; Bayliss, D.L.; Blancato, J.N.; Bloom, M.; Cohn, M. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Jun 1987. 171p. (EPA—600/8-87/029A). NTIS, PC A08/MF A01.

New information on cytotoxicity, genotoxicity, and epidemiology has raised some questions about the federal regulatory agen-

cies' cancer risk assessments for dichloromethane (DCM, methylene chloride). In addition, physiologically based pharmacokinetic models have been developed, showing that tissue-level delivery of metabolically activated DCM may be disproportionately reduced at low exposure levels. These studies suggest to some that the clear carcinogenic response seen in mice under chronic high exposures does not imply substantive human risk at low doses. The Health/ Risk Assessment Committee (HRAC), comprising representatives of four federal regulatory agencies, was convened to conduct joint analyses of these new data. The document reports on the HRAC's consideration of the data and the questions they raise about human cancer risk from DCM. It serves as a source of up-to-date analyses that may be drawn upon by each agency as it considers modifying its cancer risk assessment. The HRAC finds that, despite new data, the mechanism of carcinogenic action of DCM remains problematical; there is no basis at present to conclude that carcinogenic response is unique to mice or confined to high exposure levels.

6559 **(PB—87-228565/XAB) Update to the health assessment document and addendum for dichloromethane (methylene chloride): pharmacokinetics, mechanism of action, and epidemiology. External review draft.** Blancato, J.N.; Hopkins, J.; Rhomberg, L. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Jul 1987. 135p. (EPA—600/8-87/030A). NTIS, PC A07/MF A01.

The document represents EPA's analysis of the weight of evidence regarding the carcinogenic potential of dichloromethane (DCM, methylene chloride) for humans. It includes revised cancer risk estimates that take into account the newest information on pharmacokinetics, mechanism of action, and epidemiology, and it discusses, in some detail, methods for incorporating pharmacokinetic information into the cancer risk assessment. The document draws on the body of work developed by the Hazard/Risk Assessment Committee (HRAC) of the Integrated Chlorinated Solvents Project, an interagency workgroup. For the present, EPA scientists have used methods that result in an approximate ninefold reduction from previous unit estimates which were based on applied dose.

6560 **(PB—87-228664/XAB) Prevention reference manual: chemical specific. Volume 9. Control of accidental releases of chlorine.** Davis, D.S.; DeWolf, G.B.; Quass, J.D.; Wert, K.P. (Radian Corp., Austin, TX (USA)). Aug 1987. 174p. (DCN—87-203-023-94-14). NTIS, PC A08/MF A01.

The manual discusses reducing the risk associated with an accidental release of chlorine. It identifies examples of potential causes of accidental releases that apply to processes that use chlorine, as well as measures that may be taken to reduce the accidental release risk. Such measures include recommendations on plant design practices; prevention, protection, and mitigation technologies; and operation and maintenance practices. It provides conceptual cost estimates of possible prevention, protection, and mitigation measures. Chlorine has an IDLH (immediately dangerous to life and health) concentration, making it a substantial acute toxic hazard.

6561 **(PB—87-229498/XAB) Toxicity evaluation for establishing IDLH values. Final report.** Price, N.H.; Yates, W.G.; Allen, S.D.; Waters, S.W. (Utah Univ. Research Inst., Salt Lake City (USA). UBTL Div.). 30 Apr 1979. 249p. (TR—1518-005). NTIS, PC A11/MF A01.

Acute whole-body inhalation toxicology from exposure to the industrial chemical, 2-aminoethanol, 2-(diethylamino)ethanol, diisopropylamine, ortho-toluidine, para-anisidine, ortho-anisidine, Aroclor 1254, phosgene, stibine, and diazomethane was tested in groups of 10 rats and 10 guinea pigs. Experimental data collected from the animal exposures is presented for each chemical used and for the differing exposure concentrations. Observations used to verify the impairment of ability of the test animals to escape, animal deaths, irreversible histopathological lesions, and the differences between control and test animal organ and body weight are presented. Data for each compound are summarized by results of chemical analyses, the type of effect, and the differences between test and control animal weight data.

6562 **(PNL-SA—15082) Histopathological reaction of the lung to Mount St. Helens volcanic ash.** Sanders, C.L. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 3p. (CONF-8710185—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001906/JAW.

From 13. annual symposium/convention of the National Society for Histotechnology; Seattle, WA, USA (11 Oct 1987).

The pulmonary toxicity of respirable particle size (count median diameter, 0.5 to 1.6 μm) Mount St. Helens volcanic ash was studied. Total particulate doses of 22 to 77 mg suspended in sterile 0.9% sodium chloride solution were given in 1 to 7 consecutive weekly intratracheal instillations. The lungs and mediastinal lymph nodes were histologically examined at intervals up to 400 days after instillation.

6563 **(PNL-SA—15201) Electric power, melatonin, and breast cancer.** Stevens, R.G. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 18p. (CONF-8709165—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000991/JAW.

From International workshop on the pineal gland and cancer; Tubingen, F.R. Germany (8 Sep 1987).

In this paper, the epidemiology of breast cancer will be discussed, followed by a brief description of the effect of electric fields on melatonin and the relation of melatonin to mammary cancer in rats. Finally, there will be a consideration of factors such as alcohol that affect melatonin and their relation to breast cancer risk. 55 refs.

5604 Other Environmental Pollutant Effects

6564 **(AD-A—184049/5/XAB) Effects of radiofrequency radiation and simultaneous exposure with mitomycin C on the frequency of sister chromatid exchanges in Chinese hamster ovary cells.** Ciaravino, V.; Meltz, M.L.; Erwin, D.N. (Texas Univ., San Antonio (USA). Health Science Center). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Environmental Mutagenesis, Vol. 9, 393-399(1987).

Chinese hamster ovary (CHO) cells were exposed for 2 hr with and without mitomycin C (MMC) to pulsed wave radiofrequency radiation (RFR) at 2450 MHz. The repetition rate of 25,000 pulses per sec (pps), and exposure geometry used, resulted in a specific absorption rate (SAR) of 33.8 W/kg. The following exposure regimens were used: 1) a 37 C water bath control; 2) a water bath temperature control (TC) in which the continuously monitored medium temperature closely followed teh temperature rise in the RFR-exposed flasks; and 3) the RFR-exposed cells in a water bath set at 37 C prior to exposure. RFR exposure resulted in a maximum cell culture medium temperature of 39.2 C. In the absence of MMC, there was no significant increase in sister chromatid exchange (SCE) in the RFR-exposed or TC groups over that of teh 37 C control. When a simultaneous treatment of RFR and MMC occurred there was no statistical difference in SCE frequency from that caused by chemical treatment alone.

6565 **(DOE/NBM—8001542) Biological effects of power-frequency electric and magnetic fields.** (USDOE Bonneville Power Administration, Portland, OR; Royal Swedish Academy of Engineering Sciences, Stockholm). Jan 1987. 21p. (IVA—323). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001542/JAW.

There is a range of well established effects of power-frequency electric and magnetic fields, but none of these effects were judged to constitute a health hazard. Recent international research in the area has been intense and a great number of investigations have been published. We find that the above judgment may still be valid even today. However, there are more studies than before showing effects. If they can be confirmed, they must be judged as being hazardous to health. Primarily, it is the magnetic field which allegedly can cause these effects. In the epidemiological studies concerning cancer and residential or occupational exposure to electromagnetic fields, there is some consistency in the different studies concerning an enhanced risk, particularly in certain forms of leukemia and for childhood tumors. 4 figs.

6566 **(SAND—87-2540C) Weather influence on air blast exiting from shock tubes.** Reed, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8710166—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001364/JAW.

From Conference on safety aspects of airblast exiting from underground magazine explosions; Alexandria, VA, USA (27 Oct 1987).

Several reports on the blast field around gun barrels have shown a somewhat different pattern of directionality than has been found around shock tubes. This problem was recently examined at Sandia because of our interest in acquiring a large naval gun for impact testing. Conclusions from this work will also be presented, along with adaptations for considering atmospheric acoustic refraction. 13 refs., 6 figs.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5859, 5862, 6283

6567 **(CONF-871075—5) Contingency planning and emergency response in construction activities: Training the construction worker.** Jones, E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02. Order Number DE88000567/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Construction activities have the potential for environmental and/or health impacts at Oak Ridge National Laboratory (ORNL) particularly as site cleanup and restoration plans are initiated. ORNL has instituted special training for all construction workers and related contractors. Individuals learn how construction activities at ORNL can potentially have adverse effects on the environment and their health, and to learn how to respond to potential chemical and radiation hazards. Workers are given a review of basic information on radiation and chemicals in a framework that emphasizes the situations in which workers or the environment may be exposed to potential risk. Specific instructions are presented on what to do when contamination is suspected, with identification of emergency procedures and response personnel. 5 refs., 1 fig.

6568 **(CONF-871075—10) Keeping safety and health up front: Training for project planning and implementation.** Jones, E.; White, D.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000568/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Training on project planning and implementation specific to the types of projects being undertaken is being included in each of the Environmental Safety and Health (ESH) management training courses ongoing at ORNL. This training focuses upon the importance of potential problem analysis and ESH resources available for assisting project managers throughout the many phases of a project. The importance of addressing ESH issues as early as the conceptual and design phases is stressed, particularly with regard to building in safeguards and contingency measures. 1 ref.

6569 **(CONF-8710184—1) Tailoring training to the need: Reaching all the workers.** Jones, E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001535/JAW.

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

By developing a comprehensive concept for radiation protection training at Oak Ridge National Laboratory, we are providing a complete program with easy access for additional radiation protection training upon demand. A framework for implementation of a program tailored to reach differing segments of the workforce quickly and effectively is outlined and illustrated with ORNL program experience. 10 refs.

6570 **(CONF-8710184—2) General employee training: Initial needs assessment.** Jones, E.; Copenhaver, E.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001304/JAW.

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

US Department of Energy Orders, including those for Emergency Preparedness, require that DOE facility employees receive a preparatory course on certain basic work practices and employee responsibilities before receiving any job-specific training. Most of this general information is required for employees to either prevent or to handle emergency situations that may arise in the workplace. While the categories are general, the information should be given at both Laboratory and individual-site levels, if possible. A simple checklist developed by Oak Ridge National Laboratory proved beneficial when assessing its general employee orientation compliance status. The checklist includes subject areas covered, organizational identities and responsibilities, and documentation needs.

6571 **(LA—11086-M) MP-Division health and safety reference handbook.** Putnam, T.M. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000994/JAW.

This report presents the objectives, organization, policies, and essential rules and procedures that have been adopted by MP Division and that form the basis of the Health and Safety Program of the Clinton P. Anderson Meson Physics Facility (LAMPF). The facility includes the beam-delivery systems for the Los Alamos Neutron Scattering Center and the Weapons Neutron Research Facility (LANSCE/WNR). The program is designed not only to assure the health and safety of all personnel, including users, in their work at LAMPF, and of MP-Division staff in their work on the LANSCE/WNR beam lines, but also to protect the facility (buildings and equipment) and the environment. 33 refs., 18 figs., 2 tabs.

6572 **(ORNL—6389) Health and Safety Research Division: Progress report, October 1, 1985-March 31, 1987.** Walsh, P.J. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88000982/JAW.

This report summarizes the progress in our programs for the period October 1, 1985, through March 31, 1987. The division's presentations and publications represented important contributions on the forefronts of many fields. Eleven invention disclosures were filed, two patent applications submitted, and one patent issued. The company's transfers new technologies to the private sector more efficiently than in the past. The division's responsibilities to DOE under the Uranium Mill Tailings Remedial Action (UMTRA) program includes inclusion recommendations for 3100 properties. The nuclear medicine program developed new radiopharmaceuticals and radionuclide generators through clinical trials with some of our medical cooperatives. Two major collaborative indoor air quality studies and a large epidemiological study of drinking water quality and human health were completed. ORNL's first scanning tunneling microscope (STM) has achieved single atom resolution and has produced some of the world's best images of single atoms on the surface of a silicon crystal. The Biological and Radiation Physics Section, designed and constructed a soft x-ray spectrometer which has exhibited a measuring efficiency that is 10,000 times higher than other equipment. 1164 refs.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 5464, 5465, 5467

6573 **(DOE/NV/10384—17) Review of soil moisture flux studies at the Nevada Test Site, Nye County, Nevada.** Tyler, S.W. (Nevada Univ., Las Vegas (USA). Water Resources Center). Apr 1987. Contract AC08-85NV10384. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014485/JAW.

This report documents almost 30 years of research on soil moisture movement and recharge at the Department of Energy, Nevada Test Site. Although data is scarce, three distinct topographic zones are represented: alluvial valleys, inundated terrains, and upland terrain. Recharge in alluvial valleys was found to be very small or negligible. Ponded areas such as playas and subsidence craters showed significant amounts of recharge. Data in the upland terrains is very scarce but one area, Rainier Mesa, shows active recharge of up to three percent of the annual average precipitation in fractured volcanic tuff. The report summarizes the results.

6574 **(DP-MS—87-74) Age and correlation of tertiary sediments in the western South Carolina Coastal Plain.** Laws, R.A.; Harris, W.B.; Zullo, V.A.; Fallaw, W.C.; Price, V. (North Carolina Univ., Wilmington (USA). Dept. of Earth Sciences; Furman Univ., Greenville, SC (USA); Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 31p. (CONF-871014—2-Vugraphs). NTIS, PC A03. Order Number DE88001372/JAW.

From Annual meeting of the Geochemical Society; Phoenix, AZ, USA (25 Oct 1987).

Integration of coastal onlap stratigraphy, calcareous nannofossil, dinoflagellate, and megafossil biostratigraphy provide new data for interpretation of age and interregional correlation of Paleocene to Oligocene deposits of the western South Carolina Coastal Plain. Clastic and calcareous sediments examined in cores and outcrops in the vicinity of the Savannah River Plant record at least seven coastal onlap cycles. Basal Tertiary sediments of the Ellenton Formation represent cycles TA1.1 - 1.3 and contain dinoflagellates of Midwayan to Sabinian age. The overlying Williamsburg Formation probably represents deposits of cycle TA2.1. The superjacent siliciclastics of the Congaree Formation contain few fossils, but may preserve transgressive and highstand deposits of cycles TA2.4 - 3.3. The overlying unit is commonly calcareous, contains nannofossils indicative of zones NP16-17 (Upper Claibornian), and marks a significant change in depositional style subsequent to the 49.5 Ma eustatic fall. "Marls" of the overlying Griffins Landing Member of the Dry Branch Formation contain micro- and megafossils of Late Eocene (Jacksonian) age and represent transgressive deposits of cycle TA4.1. The discontinuous lateral distribution of these calcareous units and overlying clastics of the Dry Branch and Tobacco Road Formations results largely from erosion and deep incision during the mid-Oligocene eustatic fall (30 Ma). The "Upland" unit is interpreted as being deposited on this erosional surface.

6575 **(ORNL/M—432) Field operations and quality assurance/quality control for Direct/Delayed Response Project soil mapping activities in the northeast region.** Lammers, D.A.; Cassell, D.L.; Lee, J.J.; Stevens, D.L.; Turner, R.S.; Campbell, W.G.; Johnson, M.G. (Oak Ridge National Lab., TN (USA); Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Apr 1987. Contract AC05-84OR21400. 137p. NTIS, PC A07/MF; 1; GPO Dep. Order Number DE88002210/JAW.

The Direct/Delayed Response Project is a three-level program designed to address the concern over potential acidification of surface waters by atmospheric deposition within the United States. The mapping phase of the northwest region soil survey was conducted during the spring of 1985 as an inventory to characterize the spatial distribution of soils, vegetation, depth-to-bedrock, and lithology of watersheds located in a region of the United States believed to be susceptible to the effects of acid deposition. This document describes the planning activities and summarizes the field operations and quality assurance/quality control activities associated with the mapping of the northwest region.

6576 **(ORNL/Sub—86-32136/2) Aquifer pump test with tracers.** Lozier, W.B.; Spiers, C.A.; Pearson, R. (Golder Associates, Inc., Atlanta, GA (USA)). Oct 1987. Contract AC05-84OR21400. 99p. NTIS, PC A05. Order Number DE88001865/JAW.

An aquifer pump test with tracers was performed in Bear Creek Valley at the Oak Ridge Facility from October 6, 1986 to October 9, 1986. The objective of the test was to determine the principal values (maximum and minimum) of aquifer transmissivity, and their directions. The well field consisted of nine wells screened in the Nolichucky Shale, part of the Conasauga group of Upper Cambrian age. The test well was pumped at a constant rate of 2.5 gallons-per-minute. Once steady state conditions were approximated, a salt solution was introduced in three different observation wells at different times to evaluate the anisotropy of the system in terms of dispersivity and effective transport porosity. Drawdown data indicated that, hydraulically, the tested volume of the aquifer responded as an anisotropic porous media. The principal values of transmissivity are on the order on 10^{-2} ft²/s and 10^{-5} ft²/s and are oriented along strike and perpendicular to strike, respectively. The aquifer has a storage coefficient of about 6×10^{-4} which indicates partially confined to confined conditions. Observed tracer breakthrough curves were matched to analytical solutions to determine values of dispersivity and effective transport porosity. Along strike, these values are about 10 feet and 4×10^{-3}, respectively. Perpendicular to strike the values may be 10 feet and 8×10^{-3}, respectively, although additional testing of longer duration will be required to confirm these results. No conclusive results could be interpreted with regard to scale and double porosity effects.

6577 **(PNL—6374) Summary of water-level measurements around the 1325-N crib during the fall of 1985 and the winter of 1986-1987.** Jensen, E.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002555/JAW.

This report provides a summary of the water-level data collected from the ground water under the Hanford Site and from the Columbia River during the fall of 1985 and the winter of 1986-1987 by the Pacific Northwest Laboratory for UNC Nuclear Industries, Inc., and more recently under the direction of Westinghouse Hanford Company. During this study, water levels were measured in 28 wells around the 1325-N crib and connecting trench to monitor the rise and fall of ground-water levels resulting from operation of this facility. Analysis of the water-level data demonstrated that the water being added to the 1325-N crib has a direct effect on the ground-water movement at the 100-N Area. When the crib is in operation, a mound of water forms below the crib, and when the crib is shut down, the mound flattens out and dissipates outward in all directions.

5802 Geophysics

REFER ALSO TO CITATION(S) 6395, 6402, 6586

6578 **(LA-UR—87-3354) Borehole Inspection System for large diameter holes.** Hawkins, W.L.; Oliver, R.D.; Lavelle, M.J. (Los Alamos National Lab., NM (USA); EG and G, Inc., Las Vegas, NV (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-8710196—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001845/JAW.

From Minerals and Geotechnical Logging Society symposium; Golden, CO, USA (1 Oct 1987).

A color camera developed for underwater applications has been adapted for use as a large diameter Borehole Inspection System (BIS). This video/photographic system has pan and tilt capabilities and remotely interchangeable lenses. A compass provides an azimuth for orientation. It is designed to operate in boreholes ranging in diameter from 1.2 m to 3.0 m. The system has a 180 degree "fisheye" lens and an inspection lens with zoom. 35 mm photographs can be taken of the same view as the video for precise

location. Video tape and 35 mm film is annotated. The primary function of the BIS is geologic investigation. Various characteristics of the geologic medium can be viewed. Lithologic types and textures can be determined. Structural features such as faults, fractures, and bedding can be scrutinized. Detail descriptions of stratigraphic sequences and contacts are possible. In combination with other borehole data and sample information, many questions about hole conditions and the geologic medium can be resolved. Field operations often demand immediate resolution of borehole problems. This system offers on-the-spot visual inspection of the drill hole and associated hardware. Large eroded zones can be evaluated and casings and liners can be inspected. Other applications such as the location and configuration of hardware left in the hole and fluid entry points are possible.

6579 **(LA-UR—87-3355) Temperature logging as an aid to understanding groundwater flow in boreholes.** Conaway, J.G. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-8710196—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001844/JAW.

From Minerals and Geotechnical Logging Society symposium; Golden, CO, USA (1 Oct 1987).

Borehole temperatures are affected by a range of physical phenomena, including drilling and engineering procedures, thermal resistivity of the rock, surface climatic changes, local heat sources and sinks, free convection of the borehole fluid, and water flows inside the borehole. As a result, temperature logs provide unique information not available from other logs. On the other hand, because the temperature log is sensitive to a variety of phenomena, one or more of these may obscure the effect being studied. In the case where groundwater is entering the borehole at one depth and exiting at another depth (or at the surface) the temperature disturbance resulting from this flow is likely to be a prominent feature of the temperature profile of the borehole. Because of this, water flows in boreholes are often a source of noise in temperature logs, obscuring the features of interest. Recently, however, unusual groundwater behavior was noted in several boreholes at the Nevada Test Site (NTS), and temperature logs were run as part of a program to study this phenomenon. In this case the groundwater flow has been the feature of interest in the logs, and the logs have been useful as an aid in understanding the water flow in those boreholes.

6580 **(NUREG/CR—4753-Vol.2) Canadian Seismic Agreement: Annual report.** Wetmiller, R.J.; Lyons, J.A.; Shannon, W.E.; Munro, P.S.; Thomas, J.T.; Andrew, M.D.; Lamontagne, M.; Wong, C.; Drysdale, J.A. (Geological Survey of Canada, Ottawa, Ontario. Geophysics Div.; Canadian Commercial Corp., Ottawa, Ontario; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Oct 1987. 37p. NTIS, PC A03/MF A01 - GPO. Order Number TI88900153/JAW.

This report describes activities undertaken by the Geophysics Division (GD) of the Geological Survey of Canada (GSC) during the period June 1986 to June 1987 and supported in part by the NRC agreement. The activities include ECTN and portable network developments, datalab developments, strong motion network developments and earthquake activity.

6581 **(NUREG/CR—5034) An update of midcontinent tectonism: Final report, September 1981-June 1987.** Hinze, W.J.; Braile, L.W.; Keller, G.R.; Lidiak, E.G. (Purdue Univ., Lafayette, IN (USA). Dept. of Earth and Atmospheric Sciences; Texas Univ., El Paso (USA); Pittsburgh Univ., PA (USA)). Oct 1987. 62p. NTIS, PC A04/MF A01 - GPO. Order Number TI88900141/JAW.

The nature of the tectonism and geodynamical processes of the midcontinent region of the United States is poorly understood because of the masking effect of relatively undisturbed Phanerozoic sediments, the short historical record of seismicity and the long earthquake recurrence interval. However, during the past decade, progress has been made in attacking these problems as a result of an improved data base which permits integration of seismicity data with ancient crustal structures and current stress orientations. Surface geophysical data together with seismicity, stress determinations and data from a few critically located deep drill holes have led to a much improved knowledge of the geological history of the crust and its physical attributes. Combining our knowledge of crustal structures, stresses, and seismicity, it is possible to relate current seismicity and tectonism to one of two models. Increasing evidence from across the midcontinent supports reactivation of pre-existing zones of crustal weakness that are appropriately oriented with respect to the stress field - the 'zone of weakness model' - as the model for the dominant contemporary tectonism and the 'local basement inhomogeneity model' as the mechanism for minor, low energy release earthquake activity.

6582 **(SAND—87-1188) Seismic background noise at the Norwegian Regional Seismic Array.** Breding, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001936/JAW.

The System Control and Receiving Station (SCARS) has been collecting spectral history data on the Regional Seismic Test Network (RSTN) since 1981 and on the Norwegian Regional Seismic Array (NRSA) since it was installed in 1984. This report details the spectral history data for the NRSA through 1986. The appendix contains spectral history data for all five RSTN stations from the time they were installed until their deactivation in September 1986.

6583 **(UCID—21157) Using the STOMP [Seismic TOMography Program] Program for tomography with strong ray bending.** Beatty, J.A.; Berryman, J.G. (Lawrence Livermore National Lab., CA (USA)). 31 Aug 1987. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88001325/JAW.

Accurate tomographic reconstructions of sound wave speed and attenuation are more difficult to obtain than are the corresponding reconstructions for x-rays or high frequency electromagnetic probes. The source of the difficulty is the common occurrence of large contrasts in acoustic or seismic wave speeds, leading to refraction and ray-bending effects. A new algorithm based on Fermat's principle has been developed to treat these problems. A description of the code STOMP (for Seismic TOMography Program) implementing the new algorithm is presented here together with a brief users manual for applications to borehole-to-borehole tomography. 3 refs., 3 figs.

6584 **(UCRL—96347) Applications of Vertical Seismic Profiling at NTS.** Burkhard, N.R. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 14p. (CONF-870961—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001886/JAW.

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

Vertical Seismic Profiling (VSP) data can be used to refine the geologic interpretation of the structural setting around an emplacement hole at NTS. Recent upgrades to the seismic recording equipment routinely fielded by the NTS logging contractor permit VSP data to be obtained quickly as needed without external support. VSP data can be used in many different ways. Traditionally, VSP data have been used as a tool to assist in the interpretation of surface seismic Common Depth Point (CDP) reflection data. LLNL has been examining several direct applications to the geologic characterization of an emplacement site. VSP data from a single surface seismic source location near an emplacement hole can be used to determine the depth and apparent dip of reflecting horizons below the bottom of the hole. With multiple surface seismic source locations, the true dip of a reflector can be determined. However, geologic interpretation is still required to properly identify the reflector. In some cases, the evidence of the presence or absence of the reflector is all that is required for containment evaluation. An example of this technique (along with its shortcomings) using data from hole, U20ar is presented. Offset VSP data are obtained when the surface source is not near the well head. This technique uses the direct and reflected energy and differs from half-refraction techniques that utilize only the refracted head waves. A convenient method of imaging these data involves the transformation of these data from the traditional VSP domain to a CDP domain. In the CDP domain, the transformed VSP data resemble a

CDP reflection section. Standard surface seismic reflection techniques can be utilized to determine the structure on a portion of the plane defined by the emplacement hole and the surface seismic source location. Data from experimental deployments of this technique at hole, U4ag are presented.

5803 Mineralogy, Petrology, And Rock Mechanics

6585 **(DOE/ER/13203—T2) Determination of thermodynamic function of minerals at high temperatures: Final report, January 1, 1985 to April 15, 1986.** Anderson, O.L. (California Univ., Los Angeles (USA). Dept. of Earth and Space Sciences). 1986. Contract FG03-84ER13203. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002311/JAW.

The objective was to measure the elastic constants of several minerals and, where needed, the thermal expansivity of new minerals at high temperatures, using the Rectangular Parallelepiped Resonance (RPR) technique. The minerals of interest were NaCl, KCl, corundum (Al_2O_3), and almandine garnet. The elastic constants of NaCl and KCl were measured at high temperatures, and those of corundum at room temperature. The thermodynamic functions for MgO and Mg_2SiO_4 have been calculated. The phase diagram of iron has been calculated up to earth core pressures showing that the composition of the inner core of the earth is almost certainly iron in its epsilon (hcp) phase. (ACR)

6586 **(DOE/ER/13321—T1) Drilling investigations of a young magmatic intrusion beneath Inyo domes, Long Valley Caldera, California: The effects of pressure, volatiles, and thermal history on chemical heterogeneity in magma systems: Final report.** Vogel T.A. (Michigan State Univ., East Lansing (USA). Dept. of Geological Sciences). 28 Sep 1987. Contract FG02-85ER13321. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000900/JAW.

Systematic chemical and mineralogical variability occurs in samples from drill holes through Obsidian Dome, the conduit to the dome, and a nearby associated feeder dike. The drill hole samples that occur at the margins of the conduit and most of the lower portion of the dome are high-Ba, low-silica rhyolites, with two populations of phenocrysts, and represent commingled magmas. Whereas samples from the dike and upper portions of the dome are low-Ba, higher silica rhyolites, and do not reflect commingled magmas, samples from the center of the conduit are low-Ba, higher silica rhyolites that are only slightly mixed. A major part of the variability within the drill core samples of the dome and conduit reflects the juxtaposition, and commingling of two distinct magmas during their passage throughout the conduit.

5805 Oceanography

REFER ALSO TO CITATION(S) 6476

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 6367, 6703, 6732, 6759, 6763

6587 **(AD-A—184200/4/XAB) Torsion as a source of expansion in a Bianchi Type i universe in the self-consistent Einstein-Cartan theory of a perfect fluid with spin density. Final report for the period ending September 1986.** Bradas, J.C. (Army Missile Command, Redstone Arsenal, AL (USA). Guidance and Control Directorate). Jun 1987. 22p. (AMSMI/TR-RD-GC—87-3). NTIS, PC A02/MF A01.

We show that a generalized (or power law) inflationary phase arises naturally and inevitably in a simple (Bianchi Type I) anisotropic cosmological model in the self-consistent Einstein-Cartan gravitation theory with the improved stress-energy-momentum tensor with spin density of Ray and Smalley. This is made explicit by analytical solution of the field equations of motion of the fluid variables. The inflation is caused by the angular kinetic energy density due to spin. The model further elucidates the relationship between fluid vorticity, the angular velocity of the inertially-dragged tetrads, and the precession of the principal axes of the shear ellipsoid. Shear is not effective in damping the inflation.

6588 **(AD-A—184257/4/XAB) Impact of varves on solar physics.** Bracewell, R.N. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). May 1987. 9p. (CSSA-ASTRO—87-9). NTIS, PC A02/MF A01.

The discovery of 680-million-year-old varves recording several millennia of fossil solar cycles, is a development that is bound to make an impact on solar physics. Already, new problems of physical understanding have been posed by the 315-year Elatina cycle and the separate 350-year cycle, or undulation. The Elatina cycle evidences itself multiplicatively in the form of amplitude modulation with a distinctive nonsinusoidal envelope, while the undulation component is additive and quasisinusoidal. Both of these periodic phenomena are present in historical records of sunspots, but would not have been discerned from modern solar observations, which do not date back far enough. The explanation of two such sharply defined periods, in addition to the less sharply defined 22-year magnetic cycle, will require an understanding of solar physics that we do not yet have. Examples of the impact that the varve discovery is beginning to make are given, and a previously proposed mechanism for driving the activity cycle is extended in terms of a magnetic wave propagated radially outward from a deep torsional oscillator.

6589 **(AD-A—184352/3/XAB) Three-halves law in sunspot cycle shape.** Bracewell, R.N. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). Jul 1987. 15p. (CSSA-ASTRO—87-8). NTIS, PC A02/MF A01.

Annual mean sunspot numbers R(t) since 1700 show evidence of a nonlinear effect, first evidenced by the detection of third harmonic in R (+ or -+) (t), the alternating representation of the magnetic (22 year) cycle of solar activity. The form of the nonlinearity proves to be a three-halves law R(t) = 3/2 power of (100< LR sub lin (t)>/83, where <LR sub lin (t)>, also an alternating quantity, is a presumed underlying or linearized sunspot number. The nonlinearity is of such a nature as to cause strong semicycles to be sharper than sinusoidal and to produce the inflexion in R (+ or -)(t) noted at sunspot minimum. A search for a physical explanation of a three-halves law reveals that just such a law results because large sunspot groups, such as occur around strong sunspot maxima, enter into the sunspot number, as conventionally defined, over more days than small groups, simply because large groups last longer. Semicycle asymmetry, which cannot result from a simple nonlinear law, is here ascribed to magnetic buoyancy acting preferentially on the antinodal layers of a traveling wave. Profiles for semicycles of different strengths were constructed on the assumption that the underlying influence is sinusoidal. Each sinusoid is distorted by the three-halves law, and then made unsymmetrical by applying a buoyancy theory for magnetized plasma rising against viscous drag. The majority of past semicycles, including those of the underlying influence that is sinusoidal, and the hypothesis that sunspots result from an upward traveling wave from a submerged 22-year oscillator.

6590 **(AD-A—184360/6/XAB) Solar magnetic and velocity fields. Annual report, 16 December 1985-30 June 1987.** Ulrich, R.K. (California Univ., Los Angeles (USA). Dept. of Astronomy). 30 Jun 1987. 14p. NTIS, PC A02/MF A01.

Contents include: fast-scan program; magnetic and velocity maps; limb shift; and differential rotation with altitude.

6591 **(CONF-8607349—1) Solar oscillations, gravitational multipole field of the sun and the solar neutrino paradox.** Hill, H.A.; Rosenwald, R.D. (Arizona Univ., Tucson (USA)). 4 Nov 1986. Contract FG02-87ER13670. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002100/JAW.

From NATO advanced workshop on mathematical aspects of gravity and supergravity; Logan, UT, USA (21 Jul 1986).

The visual solar oblateness work and the solar seismological work on the internal rotation of the sun are reviewed and their implications concerning the static gravitational multipole moments of the sun are discussed. The results of this work are quite deviant which is indicative of the complexity encountered and of the necessity for continued studies based on a diverse set of observing techniques. The evidence for phase-locked internal gravity modes of the sun is reviewed and the implications for the solar neutrino paradox are discussed. The rather unique possibility for testing the relevance which the phase-locked gravity modes have to this paradox is also noted. The oscillating perturbations in the sun's gravitational field produced by the classified internal gravity modes and the phase-locked modes are inferred from the observed temperature eigenfunctions. Strains of the order of 10^{-18} in gravitational radiation detectors based on free masses are inferred for frequencies near 100 μHz. The relevance of these findings is discussed in terms of a new technique for use in solar seismological studies and of producing background signals in studies of low-frequency gravitational radiation. 64 refs., 2 figs.

6592 **(CONF-8708168—1) Perturbations of the sun's gravitational field due to solar oscillations.** Hill, H.A. (Arizona Univ., Tucson (USA)). 20 Oct 1987. Contract FG02-87ER13670. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002099/JAW.

From International symposium on experimental gravitational physics; Guangzhou, China (3 Aug 1987).

Considerable evidence has been presented for the detection of low-degree internal gravity modes of the Sun. By combining the observations obtained at the Crimean Astrophysical Observatory and at SCLERA, a number of the modes have been classified with respect to their spatial properties. The number of such modes classified has been extended in a subsequent gravity-mode classification project by Gu and Hill. These mode classifications have been tested using three additional sets of independent observations. Positive results have been obtained in each of these tests. These low-degree modes lead to oscillatory perturbations of the Sun's gravitational field. The amplitudes of these perturbations at the earth are inferred from the observed temperature eigenfunctions. For the $l = 2$ modes with frequencies near 100μHz, it is projected that these perturbations in the gravitational field will produce strains of the order of 1.0E-18 in gravitational radiation detectors based on free masses. The signals are expected to have coherence times of hundreds or more years. The detection of these signals by gravitational radiation detectors would make available a new technique for use in solar seismological studies which could be quite useful. The detection of these signals could also serve as a way of monitoring the performance of a given set of gravitational radiation detectors. 19 refs., 2 tabs.

6593 **(IFT-P—10/87) On higher derivative gravity.** Accioly, A.J. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700619/JAW.

A possible classical route conducting towards a general relativity theory with higher-derivatives starting, in a sense, from first principles, is analysed. A completely causal vacuum solution with the symmetries of the Goedel universe is obtained in the framework of this higher-derivative gravity. This very peculiar and rare result is the first known vcuum solution of the fourth-order gravity theory that is not a solution of the corresponding Einstein's equations.

6594 **(IFT-P—13/86) Qualitative methods in nonhomogeneous cosmology.** Francisco, G. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700620/JAW.

Methods of qualitative dynamical systems are introduced in the study of general gravitational fields near the initial singularity. Using a synchronous reference frame it is proved that any cosmological singularity in a globally hyperbolic spacetime contains in its neighborhood a region where the metric tensor is close to a generalized Kasner universe. Consequences of this result in the description of the behaviour of Einstein's equations near the singularity are emphasized.

6595 **(IFVE-OTF—86-207) On the time delay of the ultrahigh-energy radiation signal from the source Cygnus X-3.** Arbuzov, B.A.; Razuvaev, E.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700649/JAW.

Submitted to the journal Pis'ma JETP.

The time delay of the signal from the source Gygnus X-3 detected by EAS observation with E ≧ 3x10/sup 14/ eV and counted off the maximum of radioburst in October, 1985 is considered. The effect is shown to get the explanation in the framework of the earlier proposed interpretation of the ulrahigh-energy radiation as free gluons. The agreement of this interpretation with the totality of experimental data is emphasized. A possibility of relict gluons to give a significant contribution to the density of a hidden mass in the Universe is discussed. 10 refs.

6596 **(KFKI—1987-35/C) Near nuclear region of comet Halley based on the imaging results of the VEGA mission.** Sagdeev, R.Z.; Szegoe, K. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700731/JAW.

After one year of the successful imaging experiment aboard VEGA space probes the experimental results and their consequences are summarized. 63 pictures of VEGA-1 with 128x128 pixels and 11 pictures of VEGA-2 with 512x512 pixels, made by four different spectral filters were analyzed. The shape of the cometary nucleus is reconstructed and different sections of nucleus are represented in a cometary reference frame. The 3D light intensity distribution of cometary nucleus is also plotted. The questions of cometary rotation, jet activity and their correlations are discussed in detail. (D.Gy.). 50 refs.; 15 figs.

6597 **(LA-UR—87-3357) Main sequence mass loss.** Brunish, W.M.; Guzik, J.A.; Willson, L.A.; Bowen, G. (Los Alamos National Lab., NM (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1987. Contract W-7405-ENG-36. 5p. (CONF-870802—26). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001842/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

It has been hypothesized that variable stars may experience mass loss, driven, at least in part, by oscillations. The class of stars we are discussing here are the δ Scuti variables. These are variable stars with masses between about 1.2 and 2.25 M/sub θ/, lying on or very near the main sequence. According to this theory, high rotation rates enhance the rate of mass loss, so main sequence stars born in this mass range would have a range of mass loss rates, depending on their initial rotation velocity and the amplitude of the oscillations. The stars would evolve rapidly down the main sequence until (at about 1.25 M/sub θ/) a surface convection zone began to form. The presence of this convective region would slow the rotation, perhaps allowing magnetic braking to occur, and thus sharply reduce the mass loss rate. 7 refs.

6598 **(LA-UR—87-3448) AGB [asymptotic giant branch]: Star evolution.** Becker, S.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-8708165—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001829/JAW.

From Symposium on the origin and distribution of elements; New Orleans, LA, USA (31 Aug 1987).

Asymptotic giant branch stars are red supergiant stars of low-to-intermediate mass. This class of stars is of particular interest because many of these stars can have nuclear processed material brought up repeatedly from the deep interior to the surface where it can be observed. A review of recent theoretical and observational work on stars undergoing the asymptotic giant branch phase is presented. 41 refs.

6599 **(N—87-27559) Research and technology. Annual report, 1986.** (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). 1986. 209p. (NASA-TM—89626; NAS—1.15:89626). NTIS, PC A10/MF A01.

Activities of the Goddard Space Flight Center are described in the areas of planets and interplanetary media, comets, astronomy and high-energy physics, solar physics, atmospheres, terrestrial physics, ocean science, sensors and space technology, techniques, user space data systems, space communications and navigation, and system and software engineering. Flight projects and mission definition studies are presented, and institutional technology is described.

6600 **(N—87-27567) Nonlinear force-free magnetic fields: Calculation and applicatin to astrophysics. Ph.D. Thesis.** Yang, W.H. (Stanford Univ., CA (USA)). Mar 1987. 115p. (NASA-CR—181196; NAS—1.26:181196; CSSA-ASTRO—87-11). NTIS, PC A06/MF A01.

The problem concerned in this work is that of calculating magnetic field configurations in which the Lorentz force (vector)j x (vector)B is everywhere zero, subject to specified boundary conditions. The magnetic field is represented in terms of Clebsch variables in the form (vector)B = del alpha x del beta. These variables are constant on any field line. The most appropriate choice of boundary conditions is to specify the values of alpha and beta on the bounding surface. It is proposed that the field lines move in the direction of local Lorentz force and relax towards a force-free field configuration. This concept leads to an iteration procedure for modifying the variables alpha and beta that tends asymptotically towards the force-free state. This method is first applied to a simple problem in two rectangular dimensions; the calculation shows that the convergence of magnetic field energy to a minimum state (force-free) is close to exponential. This method is then applied to study some astrophysical force-free magnetic fields, such as the structures and evolution of magnetic fields of rotating sunspots and accretion disks. The implication of the results, as related to the mechanisms of solar flares, extragalactic radio sources and radio jets, are discussed.

6601 **(N—87-27568) Coordinated ultraviolet and radio observations of selected nearby stars. Final technical report.** Lang, K.R. (Tufts Univ., Medford, MA (USA)). Sep 1987. 50p. (NASA-CR—181089; NAS—1.26:180189). NTIS, PC A03/MF A01.

All of the US2 shifts assigned were successfully completed with simultaneous International Ultraviolet Explorer (IUE) and the Very Large Array (VLA) observations of the proposed target stars. The target stars included dwarf M flare stars and RS CVn stars. The combined ultraviolet (IUE) and microwave (VLA) observations have provided important new insights to the radiation mechanisms at these two widely-separated regions of the electromagnetic spectrum. The VLA results included the discovery of narrow-band microwave radiation and rapid time variations in the microwave radiation of dwarf M flare stars. The results indicate that conventional radiation mechanisms cannot explain the microwave emission from these stars. In general, ultraviolet variations and bursts occur when no similar variations are detected at microwave wavelengths and vice versa. Although these is some overlap, the variations in these two spectral regions are usually uncorrelated, suggesting that there is little interaction between the activity centers at the two associated atmospheric levels.

6602 **(N—87-27571) Analysis and interpretation of X-ray pulsars. Final technical report.** Boynton, P.E.; Deeter, J.E. (Washington Univ., Seattle (USA)). Aug 1987. 3p. (NASA-CR—181195; NAS—1.26:181195). NTIS, PC A02/MF A01.

By careful measurements of the fluctuations in pulsar pulse periods on time scales of days and longer, researchers determined that these fluctuations are caused by changes in the rotation rate of the stellar crust apparently arising from matter accretion. The study of these fluctuations is a particularly promising way to determine the properties of accreting pulsars, because stellar rotation is relatively simple in comparison to much other x-ray source physics and can be investigated in detail. Rotation rates can be determined precisely.

6603 **(N—87-27581) Modeling and investigative studies of Jovian low frequency emissions. Final report.** Menietti, J.D.; Green, J.L.; Six, N.F.; Gulkis, S. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1986. 62p. (NASA-TM—89299; NAS—1.15:89299). NTIS, PC A04/MF A01.

Jovian decametric (DAM) and hectometric (HOM) emissions were first observed over the entire spectrum by the Voyager 1 and 2 flybys of the planet. They display unusual arc-like structures on frequency-versus-time spectrograms. Software for the modeling of the Jovian plasma and magnetic field environment was performed. In addition, an extensive library of programs was developed for the retrieval of Voyager Planetary Radio Astronomy (PRA) data in both the high and low frequency bands from new noise-free, recalibrated data tapes. This software allows the option of retrieving data sorted with respect to particular sub-Io longitudes. This has proven to be invaluable in the analyses of the data. Graphics routines were also developed to display the data on color spectrograms.

6604 **(N—87-27585) Investigation of short period oscillations of the solar irradiance and their time variations. Final technical report, 15 February 1985-14 December 1986.** Noyes, R.W. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Aug 1987. 12p. (NASA-CR—180340; NAS—1.26:180340). NTIS, PC A02/MF A01.

Measurements of solar irradiance fluctuations by the Active Cavity Radiometer (ACRIM) instrument onboard the Solar Maximum Mission (SMM) show variations on a time scale of about 5 minutes due to solar p-mode oscillations, as well as longer-term variations related to solar magnetic activity. The question was studied whether the p-mode frequencies change with time as a result of changing solar structure associated with the activity cycle. The ACRIM data on SMM are particularly well-suited for this purpose, because the instrument operated continuously from February 1980 to December 1980 and again from May 1984 to the present. The main activity entailed a detailed study of the observational data to determine if a change in the p-mode frequencies is evident from the time of solar maximum to that of solar minimum. It was concluded that the measured eigenfrequencies were significantly higher during the 1980 time frame than during the 1984 to 1986 time frame. The conclusion that there is significant change in the eigenfrequencies with the activity cycle remains only tentative, and needs confirmation from analysis of more data during the upcoming solar maximum.

6605 **(N—87-28493) Exploration of the solar-stellar connection at high spectral resolution with the Ultraviolet Spectrometer and Polarimeter, and studies of thermal bifurcation at the photosphere-chromosphere interface. Final Report.** (Colorado Univ., Boulder, (USA). Cooperative Inst. for Research in Environmental Sciences). 1987. 7p. (NASA-CR—181295; NAS—1.26:181295). NTIS, PC A02/MF A01.

The dynamics of high-excitation plasma in the 100,000 K transition zones of stars of late spectral type, as observed with the International Ultraviolet Explorer, was compared with the radial gas velocities of individual structural features of the solar TZ, as observed with high spatial resolution by the UVSP on the Solar Maximum Mission. The 4th-positive system of carbon monoxide in the quiet sun and in active regions was studied in order to explore the properties of thermal inhomogeneities at the critical interface between the photosphere and chromosphere.

6606 **(NEI-NO—31) Atmospheric activity in red dwarf stars.** Pettersen, B.R. (Tromsoe Univ. (Norway)). 1986. 163p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750357/JAW.

Reprints of nine previously published papers.

Active and inactive stars of similar mass and luminosity have similar physical conditions in their photospheres, outside of magnetically disturbed regions. Such field structures give rise to stellar activity, which manifests itself at all heights of the atmosphere. Observations of uneven distributions of flux across the stellar disc have led to the disovery of photospheric starspots, chromospheric plage areas, and coronal holes. Localized transient behavior has

been identified in both thermal and non-thermal sources, such as flares, shock waves and particle acceleration. The common element to all active regions is the presence of strong magnetic field structures connecting the violently turbulent deep layers in the convection zones of stars with the tenuous outer atmospheres. Transport and dissipation of energy into the chromospheric and coronal regions are still much debated topics.

6607 **(NEI-NO—32) On the measurements of large scale solar fields.** Andersen, B.N. (Oslo Univ. (Norway)). 1985. 123p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750358/JAW.

A general mathematical formulation for the correction of the scattered light influence on solar Doppler shift measurements has been developed. This method has been applied to the straylight correction of measurements of solar rotation, limb effect, large scale flows and oscillations. It is shown that neglecting the straylight errors may cause spurious large scale velocity fields, oscillations and erronous values for the solar rotation and limb effect. The influence of active regions on full disc velocity measurements has been studied. It is shown that a 13 day periodicity in the global velocity signal will be introduced by the passage of sunspots over the solar disc. With different types of low resolution apertures, other periodicities may be introduced. Accurate measurements of the center-to-limb velocity shift are presented for a set of magnetic insensitive lines well suited for solar velocity measurements. The absolute wavelenght shifts are briefly discussed. The stronger lines have a "supergravitational" shift of 300-400 m/s at the solar limb. The results may be explained by the presence of a 20-25 m/s poleward meridional flow and a latitudinal dependence of the granular parameters. Using a simple model it is shown that the main properites of the observations are explained by a 5% increase in the granular size with latitude. Data presented indicate that the resonance line K I, 769.9 nm has a small but significant limb effect of 125 m/s from center to limb. 51 refs. Reprints of seven previously published papers.

6608 **(PB—87-225207/XAB) Observation and interpretation of solar S-component radiation at millimetre waves.** Hildebrandt, J.; Krueger, A.; Urpo, S.; Teraesranta, H. (Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.). 1987. 28p. (S—170). NTIS, PC E03/MF A01.

This report summarizes methods and results of a study of single sources of the slowly varying component (S-component) of the solar radio emission at mm waves. There is included a list of the available data (referring to source positions at heliographic longitudes within + or - 50 deg from the central meridian) derived from solar maps obtained at Metsahovi during the period 1978-1984. The measuring frequencies are 11.6, 22.2, 36.8, 77.1, and 80.5 GHz. The observations are interpreted by means of model calculations applying radiative transfer of Coulomb bremsstrahlung and gyromagnetic emission. Examples of those calculations are shown in form of tables. Accurate agreement between calculation and observation implies the existence of subtelescopic inhomogenous structures of the radiating plasma (according to the presence of sunspots, bright plage elements, and a quasi-quiet background).

6609 **Arc minute gravitational lenses and cosmic strings; and reply.** Bennett, D.P.; Stebbins, A.; Paczynski, P. (Fermi National Accelerator Lab., Batavia, IL, USA; California Univ., Berkeley, USA. Dept. of Physics; Princeton Univ., NJ, USA. Observatory). *Nature (London);* **324**: No. 6095, 392-393(27 Nov 1986). Contract AC03-76SF00515.

Letters to the editor.

6610 **Matter domination-recombination: coincidence or consequence.** Schramm, D.N.; Vishniac, E. (Chicago Univ., IL, USA. Astronomy and Astrophysics Center; Fermi National Accelerator Lab., Batavia, IL, USA; Texas Univ., Austin, USA). *Comments on Nuclear and Particle Physics;* **16**: No. 1, 51-55(May 1986). Contract AC02-80ER10773.

It is a well known cosmological coincidence that the transition in the expanding universe from radiation domination to matter domination occurs at roughly the same time and temperature as the transition from atoms being ionized to being neutral. It is argued here that this might not be a coincidence at all but a cosmological problem to be solved by super grand unified theories, just as they were used to solve the problem of baryon asymmetry, the horizon problem, and the flatness problem. The solution requires a special relationship between the parity violation of the baryon nonconserving interaction and the fine structure constant.

6611 **Evolution of supernova progenitors and supernova models.** Nomoto, K. (Dept. of Earth Science and Astronomy, College of Arts and Sciences, Univ. of Tokyo, Meguro-ku, Tokyo 153). pp 294-319 of Proceedings of the 12th Texas symposium on relativistic astrophysics. Livio, M.; Shaviv, G. New York, NY; The New York Academy of Sciences (1986). (CONF-841238—).

From 12. Texas symposium of relativistic astrophysics; Jerusalem, Israel (17 Dec 1984).

Supernovae are the stellar explosions releasing energies of about 10/sup 51/ ergs and shining as bright as a whole galaxy. Because of their enormous energy impulse, supernovae have strong influences on the interstellar medium. Supernovae are important sights of nucleosynthesis and eject a lot of heavy elements into space. Some supernovae leave neutron stars or black holes behind. Thus supernovae are one of the key events in the evolution of stars, galaxies, and the universe. The understanding of supernovae and their remnants is being accelerated by the recent progresses in observations at all wave bands and in theoretical modeling. From the observational side, supernovae are classified as Type I and Type II. This classification is based on spectroscopy: Type I supernovae (SN-I) are hydrogen-deficient, while Type II supernovae (SN-II) show hydrogen lines in their spectra near maximum light (e.g., see reference 1). SN-I and SN-II have several other distinct features which are described in this paper. Guided by these progress facts of supernovae, the origin of supernovae has been extensively explored. The currently most-favored candidates of supernova progenitors are massive red-supergiants and white dwarfs.

6612 **The future of solar physics.** Parker, E.N. (Fermi Institute, Univ. of Chicago, Chicago, IL). pp 599-619 of Proceedings of the 1984 summer study on the design and utilization of the Superconducting Super Collider. De Jager, C.; Svestka, Z. Hingham, MA; D. Reidel Publishing Co. (1986). (CONF-8406198—).

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

The future of solar physics is founded on the existing fundamental unsolved problems in stellar physics. Thus, for instance, the physics of stellar interiors has been called into serious question by the very low-measured neutrino flux. The /sup 71/Ga neutrino detection experiment is the next step in unravelling this mystery. If that experiment should find the expected neutrino flux from the basic p-p reaction in the Sun, then astrophysics is in a difficult situation, because the most likely explanation for the low neutrino flux found in the /sup 37/Cl experiment would be an error in the calculation of the opacity or an error in the understanding of the elemental abundances in stellar interiors, with serious implications for present ideas on stellar structures and the age of the galaxy. The new method of helioseismology, for probing the interior of the Sun, have already found the primordial rapid rotation of the central core. The forthcoming world-wide helioseismology observing network will permit fuller exploitation of the method, promising to provide the first direct sounding of the interior of a star, hitherto known to us only through theoretical inference and the discrepant neutrino emission. An essential step in developing the physics of stellar activity will be the Solar Optical Telescope (presently planned by NASA to be launched early in the next decade) to permit a microscopic examination of the surface of the Sun to study the source of the action. The activity and X-ray emission of other stars depend on much the same effects, so that the study is essential to determining the significance of the X-ray emission from other stars.

6613 **Formation of a bar through cold collapse of a stellar system.** Kim, S.Y.; Lee, H.M.; Min, K.W. (Plasma Physics Lab., Princeton Univ.). pp 219-222 of The use of supercomputers in stellar dynamics. Hut, P.; Mc Millan, S. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-8606175—).

From Workshop on the use of supercomputers in stellar dynamics; Princeton, NJ, USA (2 Jun 1986).

The author have converted the plasma physics electrostatic code to a gravitational N-body code for astrophysical applications. The code has a particle mesh (PM) scheme and incorporates finite-size particles of Gaussian shape with scale length a. In plasma physics, a is usually of the order of Debye length. However, in the self-gravitating system a is simply a softening parameter having no particular physical meaning. The use of finite-size particles eliminates the singular behavior of the point particles in the short-range interactions. They have chosen a to be the mesh size in computation discussed below, but the results are not sensitive to the choice of a. The FFT and linear interpolation have been used to evaluate the potential and the leap-frog scheme has been employed to integrate the equation of motion. Since the code was originally written for the Cray system, it is highly vectorized and supposedly runs very efficiently on parallel machines.

6614 **Remarks on stellar clusters.** Teller, E. (Lawrence Livermore National Lab., CA, USA; Hoover Institution, Stanford, CA, US). pp 321-324 of From SU(3) to gravity. Festschrift in honor of Yuval Ne'eman. Gotsman, E.; Tauber, G. (eds.). Cambridge, England; Cambridge University Press (1985).

In the following, a few simple remarks on the evolution and properties of stellar clusters will be collected. In particular, globular clusters will be considered. Though details of such clusters are often not known, a few questions can be clarified with the help of primitive arguments. These are:- why are spherical clusters spherical, why do they have high densities, why do they consist of approximately a million stars, how may a black hole of great mass form within them, may they be the origin of gamma-ray bursts, may their invisible remnants account for the missing mass of our galaxy. The available data do not warrant a detailed evaluation. However, it is remarkable that exceedingly simple models can shed some light on the questions enumerated above.

6402 Atmospheric Physics

6615 **(AD-A—184196/4/XAB) Absence of Region 1/ Region 2 field-aligned currents during prolonged quiet times.** Rich, F.J.; Gussenhoven, M.S. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jul 1987. 5p. (AFGL-TR—87-0252). NTIS, PC A02/MF A01.

Pub. in Geophysical Research Letter, Vol. 14, No. 7, 689-692(Jul 1987).

Using magnetic-field and precipitating-particle data from the DMSP/F7 satellite, it was found that, during extended periods of geomagnetic quiet, the large-scale field-aligned current (FAC) system known as Region 1/Region 2 either does not exist or is too small to be observable. A clear dayside cleft FAC system is observed on the preferred side of local noon for the indicated IMF By component, and the cleft electron precipitation extends far into the region normally considered to be the polar cap. These quiet periods represent times when energy input from the solar wind is low; the IMF is maintained at near zero or slightly northward levels and the solar wind speed is low. For such times, the Kp index is < or = 1 for several consecutive 3-hour periods. In these cases, the auroral zone is marked by diffuse electron precipitation, and only small-scale or fine-scale FAC's. In the polar cap, electron precipitation is characterized by polar rain and there are no FAC systems (including the NBZ system). Some previous reports imply that one should always find this large-scale Region 1/Region 2 system during quiet times. It is suggested that the Region 1/Region 2 system vanishes 10's of mins to hrs after the IMF has turned northward.

6616 **(AD-A—184466/1/XAB) High latitude f-region drift studies. Technical report, October 1985-September 1986.** Reinisch, B.W.; Buchau, J.; Weber, E.J.; Dozois, C.G.; Bibl, K. (Lowell Univ., MA (USA). Center for Atmospheric Research). Dec 1986. 28p. (ULRF—436/CAR). NTIS, PC A03/MF A01.

The large-scale, high-latitude ionospheric-convection pattern is driven by the interaction of the solar wind and the interplanetary magnetic field with the earth's magnetosphere. Ground-based digital ionosondes, with spaced receiving antennas, have been developed and deployed at the high latitude stations of Thule, Greenland and Goose Bay, Labrador. Results from these stations demonstrate that the ionospheric convection can be measured for the bottomside ionosphere. Data from Thule consistently show the predominant antisunward convection. The data from Goose Bay indicate the sunward return flows of the polar plasma convection and the switch over when the station rotates from the dusk into the dawn cell. These data also illustrate the potential for systematic study of the convection patterns that is possible with a network of ground-based digital ionosondes.

6617 **(AGARD-CP—406) Aerospace environment at high altitudes and its implications for spacecraft charging and communications.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). May 1987. 286p. (CONF-8606353—). NTIS, PC A13/MF A01.

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

The symposium examined how the magnetosphere and polar plasmas vary as a result of natural causes and man-made perturbations, and the implications of these variations for the charging and differential charging of spacecraft with their effects, in turn, on spacecraft systems and communications. A better understanding of these phenomena can help to design of spacecraft systems and subsystems to minimize the effects of these disturbances.

6618 (AGARD-CP—406, pp vp) **Quiet and distrubed plasmasphere.** Lemaire, J. May 1987. NTIS, PC A13/MF A01. (CONF-8606353—).

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

The plasmasphere and plasmapause are described from an observational point of view. The main properties of this inner magnetospheric region are recalled. The dynamical response of the plasmasphere to enhancements of geomagnetic activity is considered. The peeling off of the nightside plasmasphere at the onset of enhanced magnetospheric convection events is discussed. The dayside refilling mechanism is addressed.

6619 (AGARD-CP—406, pp vp) **Magnetospheric control of the bulk ionospheric plasma.** Sojka, J.J.; Schunk, R.W. May 1987. NTIS, PC A13/MF A01. (CONF-8606353—).

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

The temperature, composition, and circulation of high latitude ionosphere display a marked variation with altitude, longitude, universal time, season, solar cycle and geomagnetic activity. To a large degree this variation is a consequence of the effect that magnetospheric electric fields, particle precipitation, and heat flows have on the ionosphere. These and other aspects of the ionosphere's response to changing magnetospheric conditions are discussed using a time dependent ionospheric model.

6620 (AGARD-CP—406, pp vp) **Model for an electromotive force generator in the magnetosphere: a source of discrete auroral arcs.** Roth, M.; Evans, D.S.; Lemaire, J. (National Oceanic and Atmospheric Administration, Boulder, CO). May 1987. NTIS, PC A13/MF A01. (CONF-8606353—).

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

Results obtained from solving Maxwell's and Vlasov's equations to obtain the electrical structure of the sheath that separates magnetospheric particle populations of different densities and temperatures are presented. It is shown that for reasonable magnetospheric plasma populations, an electric potential difference of several kilovolts exists across such a boundary. The potential can serve as the necessary electromotive force for the auroral current circuit. The colocation between a magnetospheric boundary and a discrete aurora is a natural consequence of this picture.

6621 (AGARD-CP—406, pp vp) **Hostile energetic particle radiation environments in Earth's outer magnetosphere.** Baker, D.N.; Belian, R.D.; Higbie, P.R.; Klebesadel, R.W.; Blake, J.B. (Aerospace Corp., El Segundo, CA). May 1987. NTIS, PC A13/MF A01. (CONF-8606353—).

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

Particular emphasis is given to highly relativistic electrons (3 approx. 10 MeV). Electron fluxes and energy spectra are shown that were measured by two high energy electron sensor systems at 6.6 R sub E from 1979 through 1984. Large, persistent increases in this population were found to be relatively infrequent and sporadic in 1979 to 1981 around solar maximum. During the approach to solar minimum (1981 to present) it is observed that the highly relativistic electrons occur with a regular 27-day periodicity and are well associated with the reestablished solar wind stream structures. The present analysis suggests that the Jovian magnetosphere is a recurrent source of this significant electron population in the outer terrestrial magnetosphere and that these electrons have a very deleterious effect on spacecraft systems due to deep dielectric charging and low-dose susceptibility effects.

6622 (AGARD-CP—406, pp vp) **Use of Pi2 pulsations as indicators of substorm effects at geostationary orbit.** Lester, M. May 1987. NTIS, PC A13/MF A01. (CONF-8606353—).

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

Some of the characteristics of Pi2 pulsations observed at mid-latitudes on the ground are reviewed and the use of certain characteristics in indicating various magnetic and particle perturbations occurring during substorms are assessed. Spacecraft charging and its effects at geosynchronous orbit also reviewed. There is a brief discussion of how Pi2 pulsations might be used to predict intervals of spacecraft charging at geosynchronous orbit.

6623 (AGARD-CP—406, pp vp) **Wave-induced particle precipitation from the magnetosphere and the associated ionospheric perturbations.** Inan, U.S. May 1987. NTIS, PC A13/MF A01. (CONF-8606353—).

From Aerospace environment at high altitudes and its implications for spacecraft charging and communications; The Hague, Netherlands (2 Jun 1986).

A brief review of the gyroresonant wave-induced precipitation of energetic radiation belt particles is presented using the particular case of interactions involving lightning-generated whistler waves as an example. The interaction physics is first discussed in the context of results from a recently developed theoretical model of the whistler-particle scattering process occurring in the magnetosphere. This is followed by a discussion of the Trimpi effect, a particularly sensitive ground-based technique that has recently been used for detecting ionospheric perturbations produced by whistler-induced energetic particle precipitation from the magnetosphere on L-shells of 2 to 5.

6624 (SAND—87-2534C) **Microsecond beam propagation in air.** Powell, E.T.; Kamin, G.W.; Wagner, J.S.; Lipinski, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-8709146—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002221/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

A 3-MeV, 2-kA, 2-μs unconditioned electron beam has been propagated a distance of 1.2 meters in air at the EPOCH facility at Sandia National Laboratories-Albuquerque. Time-integrated photographs show stable propagation throughout the entire distance the beam was visible (~2 L/sub N/ or ~5 λ/sub β/). Additional experiments were performed in an evacuated, 14-meter long tank at pressures between 15 mT and 100 T. In these cases no stable propagation was observed above 50 mT. Below mT the beam was marginally stable. The OOSIK simulation code was run for the open air case with reasonable agreement. 2 refs., 1 fig., 1 tab.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 6259, 6380, 6408, 6624, 6651, 6910

6625 (BNL—40288) **Charge state evolution in an ion trap irradiated by VUV synchrotron radiation.** Meron, M.; Johnson, B.M.; Jones, K.W.; Church, D.A. (Brookhaven National Lab., Upton, NY (USA); Texas A and M Univ., College Station (USA)). Sep 1987. Contract AC02-76CH00016. 22p. (CONF-8708164—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001556/JAW.

From International conference on spectroscopy and structure of highly ionized atoms; Lisle, IL, USA (17 Aug 1987).

The energies of photons obtainable from the VUV ring at the National Synchrotron Light Source (NSLS) are ideally suited for high-efficiency ionization of atomic outer-shell electrons. Given the high fluxes of photons available on a wiggler beam line, multiple photoionization in an ion trap can be easily achieved within times short compared to typical ion storage times in the trap. Measurements of the time evolution of ion populations in such a trap can yield ionic photoionization cross sections and charge-exchange interaction rates for ion-atom or ion-ion collisions. The various processes governing this time evolution are discussed and model calculations illustrating the relative importance of these processes under different conditions are presented. 8 refs., 5 figs., 1 tab.

6626 (CONF-870152—4) **Experiments with recoil ions and other considerations.** Cocke, C.L. (Kansas State Univ., Manhattan (USA). J.R. MacDonald Atomic and Nuclear Science Lab.). 1987. Contract FG02-86ER13491. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001690/JAW.

From Workshop on opportunities for atomic physics using slow, highly-charged ions; Argonne, IL, USA (12 Jan 1987).

Some opportunities in collisions physics with slow, multiply charged ions are addressed. A distinction between inner and outer shell collisions is drawn. The applicability of recoil ion sources to outer shell collision systems is discussed, with emphasis on the quality of the beam desired. An example of an inner shell collision is discussed, and the usefulness of not pushing the collision energy too low is pointed out. 13 refs., 14 figs.

6627 (ITEF—68(1986)) **1/n expansion in the Stark effect problem.** Vajnberg, V.M.; Mur, V.D.; Popov, V.S.; Shcheblykin, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700680/JAW.

The earlier developed 1/n - expansion method is applied to a problem on the hydrogen atom in a homogeneous electric field E (the Stark effect). The following questions are considered: classical approximation, n -> ∞; recurrent relations for the higher corrections E/sup (x)/ in 1/n expansion convergence of 1/n - expansion at different n and E. 15 refs.; 4 figs.

6628 (ITEP—9(1986)) **Towards a theory of weak hadronic decays of charmed particles.** Blok, B.Yu.; Shifman, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700689/JAW.

Weak decays of charmed mesons are considered. A new quantitative framework for theoretical analysis of nonleptonic two-body decays based on the QCD sum rules are proposed. This is the first of a series of papers devoted to the subject. Theoretical foundations of the approach ensuring model-independent predictions for the partial decay widths are discussed. 57 refs.; 7 figs.

6629 (JINR-R—17-86-614) **Multi-photon transitions in three-level systems.** Kochetov, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700726/JAW.

Submitted to the journal J. Phys., A.

An exaxt solution is found to the problem related to interaction of a three-level atom with a double-mode field of scalar photons, their production and annihilation operators being introduced into the interaction Hamiltonean nonlinearly. Hamiltonian invariance in realtion to combined phase transformations of bose-field and dipole atomic transition operators leads to conservation of the system charges which in turn, allows one to search for exact state vector in the form of decompositions of these charges. It is stressed that in the resonance case in contrast to other, less general problems of such a type, some energy levels of the system under consideration are doubly degenerated which testifies to the existence of an additional motion integral in the system. 9 refs.

6630 **(LBL—23989) Near threshold behavior of photoelectron satellite intensities.** Shirley, D.A.; Becker, U.; Heimann, P.A.; Langer, B. (Lawrence Berkeley Lab., CA (USA); Wuerzburg Univ. (Germany, F.R.). Physikalisches Inst.; Technische Univ. Muenchen, Garching (Germany, F.R.). Physikdepartment; Technische Univ. Berlin (Germany, F.R.). Inst. fuer Strahlungs- und Kernphysik). Sep 1987. Contract AC03-76SF00098. 14p. (CONF-8709135—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002231/JAW.

From 14. international conference on X-ray and inner-shell processes; Paris, France (14 Sep 1987).

The historical background and understanding of photoelectron satellite peaks is reviewed, using He(n), Ne(1s), Ne(2p), Ar(1s), and Ar(3s) as case studies. Threshold studies are emphasized. The classification of electron correlation effects as either "intrinsic" or "dynamic" is recommended. 30 refs., 7 figs.

6631 **(OUP—87-18) G-factor in molecular nitrogen, oxygen and air.** Mentzoni, M. (Oslo Univ. (Norway). Fysisk Inst.). Jun 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750353/JAW.

The electron energy relaxation in molecular nitrogen and oxygen is found experimentally using the methods of microwave cross-modulation, transport coeffisients, and flowing afterglows. On the basis of these results the excess electron energy loss factor, the G-factor, has been computed for nitrogen, oxygen and air as a function of electron temperature for various published effective electron collision frequencies. It is shown that the lack of a definitive theory for rotational excitation of O/sub 2/, and very conflicting experimental results for this gas, yield a G-factor in air with a large degree of uncertainty. In spite of this uncertanty it is shown that the formula G = 18.9 x T/sup -1.5/, with T being the electron temperature in deg. K, agrees within 15% of the results obtained from swarm data and microwave cross-modulation. 38 refs.

6632 **(SAND—87-1230C) Rotational dynamics and electronic energy partitioning in the electron-stimulated desorption of NO from Pt(111).** Burns, A.R.; Stechel, E.B.; Jennison, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-871125—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002261/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

Using laser resonance-ionization, we have examined the rotational dynamics of neutral NO molecules desorbed by electron impact from a cold (80 K) Pt(111) surface. Previously, we observed "hot" rotational temperatures in the range of 481-642 K for the nu = 0, 1, 2, and 3 vibrational levels. We now present more detailed data which does not reveal shifts or broadening in the rotationally-selected NO velocity distributions as a function of rotational level J in the range J = 2.5 to 29.5. The rotationally-independent velocity distributions, peaked at 0.05 eV, as well as the rotational temperature can be understood within the framework of "electronically-stimulated adsorbate rotation." The model predicts complete rotational alignment in a plane normal to the surface. In the laboratory, no alignment is observed; but this is most likely due to the presence of stray magnetic fields. We will also discuss our measurements which show an equal partitioning between the two lowest NO electronic states (^{2}PI/sub 1/2/ and ^{2}PI/sub 3/2/), and a preference for the π level which is perpendicular (antisymmetric) to the plane of rotation. 16 refs., 3 figs.

6633 **(SFTI—87-1) On splitting of weakly-bound systems.** Maksimov, M.Z.; Chikovani, Z.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi. Fiziko-Tekhnicheskij Inst.). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700744/JAW.

The equality of total cross sections of weakly-bound system (A+c) disintegration and total cross sections of scattering of light fragment c is shown on one and the same targets and with equal velocities in the region of high energies, which is in a fair agreement with reached world data. 7 refs.; 1 fig.

6634 **(UCRL—15948) The thermophysics of electron beam evaporative sources: Annual report, 21 April 1986-20 April 1987.** Self, S.A. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Jun 1987. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002451/JAW.

This report presents work accomplished in preparing equipment for study of evaporative electron beam sources. Faraday cups and x-ray imaging equipment were developed. Due to other commitments, the future of this work is uncertain. (JDH)

6635 **Thermionic cathode electron gun for high current densities.** Herniter, M.E.; Getty, W.D. (Dept. of Electrical Engineering and Computer Science, Univ. of Michigan, Ann Arbor, MI 48109). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 351-360(Aug 1987).

An electron gun using lanthanum hexaboride (LaB/sub 6/) as a cathode material is being studied for use as a robust thermionic emitter at high cathode current densities. It has a standard planar cathode, Pierce-type electron gun design with a space-charge-limited perveance of 3.2 x 10/sup -6/ A/V/sup 3/2/. Thus far it has been operated up to 36 kV in the space-charge-limited regime. The cathode is heated by electron bombardment and radiation from an auxiliary tungsten filament. The total heating requirement is found to be 202 W/cm/sup 2/ of cathode area at a cathode temperature of 1626°C. These observations are found to be in reasonable agreement with a thermal steady-state power balance model. Beam current distribution measurements are made with a movable collector and Faraday cup, and are found to be in agreement with an electron-gun computer code. The cathode temperature distribution is also measured.

6636 **On the current intensity limit of a vacuum-arc ion source.** Brown, I.G. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 346-350(Aug 1987). Contract AC03-76SF00098.

The maximum ion current that can be extracted as a high-energy beam from a metal-vapor vacuum-arc ion source is considered. Results are presented of measurements of the plasma ion current in the metal-vapor vacuum-arc II (MEVVA II) ion source. It is shown that this source is an efficient generator of metal ions, an intense flux of which is efficiently transported to the beam extractor. The maximum metal-ion current that is available for extraction at the extractor location is 5 percent of the arc current. The limitation to the intensity of the metal-ion beam that can be produced by this kind of ion source is found to be in the extractor design.

6637 **Spectroscopic study of anode plasmas in a microsecond electron beam diode.** Cuneo, M.E.; Gilgenbach, R.M.; Brake, M.L. (Intense Energy Beam Interaction Lab., Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI 48109-2104). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 375-383(Aug 1987).

Experiments have been performed to investigate the visible emissions (370-600 nm) from long-pulse electron-beam-driven carbon anode plasmas, and to correlate the spectroscopic evidence for ions with deviations of the diode current and voltage from Child-Langmuir behavior. Electron beams had peak voltages of ~0.8 MV, current densities approaching 10/sup 3/ A/cm/sup 2/, and

pulselengths of about 1 μs. Diode closure resulted in three phases of the beam/plasma evolution. In stage I the deposited electron dose was smaller than that required for anode plasma optical emission (≦250 J/gr). No deviations of the diode operation from conventional Child-Langmuir scaling were observed. In stage II, the electron dose was large enough for anode plasma formation before shorting (≦350 J/gr), and low-intensity optical emission was primarily from CII and CIII. During stage II, two types of non-Child-Langmuir diode behavior occurred due to the presence of an anode plasma. An anomalous voltage peaking behavior occurred at an average dose of 740 J/gr, at about 80 percent of the diode shorting time. The diode impedance was constant during this voltage peaking behavior, contrary to the impedance collapse expected from Child-Langmuir behavior in a closing diode. This voltage peaking was accompanied by an increase in continuum emission, particularly at shorter wavelengths. A bipolar impedance level was occasionally observed before voltage peaking, at an average dose of 4120 J/gr, at about 66 percent of the predicted shorting time. During stage III, an intense vacuum arc mode, the cathode plasma shorted the anode-cathode (A-K) gap, resulting in intense optical emission from CI through CIV on noncrowbarred pulses, and from CII, C/sub 2/, CH, and H on crowbarred pulses.

6638 **Fine-structure effect for electron impact excitation of n³Psub(0,1,2) states of LS-coupled atoms. Pt. 1. Helium.** Csanak, G.; Cartwright, D.C. (Los Alamos National Lab., NM, USA). *Journal of Physics B: Atomic and Molecular Physics;* **20**: No. 2, L49-L54(28 Jan 1987).

A simple relationship between the electron spin polarisation function and the electron-photon coherence and correlation parameters associated with the excitation of n^3P target states by an unpolarised incident electron beam is derived for LS-coupled target initially in a $^1S_0$ state. This relationship is useful because it facilitates the experimental determination of the electron spin polarisation functions associated with this particular type of excitation process through the measurement of the lambda and chi coherence and correlation parameters, thus avoiding the necessity of measuring the spin of the scattered electrons directly. This relationship is illustrated by using first-order many-body theory to predict the electron spin polarisation functions associated with the excitation of the n³Psub(J) (n 2,...,8; J = 0, 1, 2) states of helium by electron impact.

6639 **Strategy for achieving spatially coherent output from laboratory X-ray lasers.** Rosen, M.D.; Trebes, J.E.; Matthews, D.L. (Lawrence Livermore National Lab., CA, USA). *Comments on Plasma Physics and Controlled Fusion;* **10**: No. 5, 245-252(Jan 1987).

Current plasma-medium laboratory x-ray laser amplifiers are far from fully spatially coherent. For future applications, such as holography, full coherence will be required. A strategy is presented for achieving this by appealing to an analogy with current high power glass laser systems; namely a single mode low power, low divergence amplifier drives a full power amplifier into fully coherent, single mode output.

6640 **Collective vector method for calculation of E1 moments in atomic transition arrays.** Bloom, S.D.; Goldberg, A. (Lawrence Livermore National Lab., Livermore, CA). pp 230-263 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The CV (collector vector) method for calculating El moments for a transition array is described and applied in two cases, herein denoted Z26A and Z26B, pertaining to two different configurations of the M-shell. The basic idea of the method is to create a CV from each of the parent ("initial state") state-vectors of the transition array by application of the El operator. The moments of each of these CV's, referred to the parent energy, are then the rigorous moments for that parent, requiring no state decomposition of the manifold of daughter state-vectors. Since, in cases of practical interest, the daughter manifold can be orders of magnitude larger in size than the parent manifold, the calculation of many moments higher than the second in situations hitherto unattainable via standard methods are made possible. The combination of the moments of all the parents, with proper statistical weighting, then yields the transition array moments from which the transition strength distribution can be derived by various procedures. The authors describe two of these procedures: the well-known GC (Gram-Charlier) expansion in terms of Hermite polynomials; and the Lanczos algorithm or Stieltjes imaging method. Application is made in the cases of Z26A (50 lines and Z26B (5523 lines) and the relative merits and shortcomings of the two procedures are discussed.

6641 **Combined effect of acceleration voltage and incident beam orientation on the characteristic X-ray production in thin crystals.** Krishnan, K.M.; Rez, P.; Thomas, Gareth; Yokota, Yasuhiro; Hashimoto, H. (Lawrence Berkeley Lab., CA, USA; Osaka Univ., Suita, Japan. Faculty of Engineering). *Philosophical Magazine, B: Electronic, Optical and Magnetic Properties;* **53**: No. 4, 339-348(Apr 1986).

A systematic experimental study has been carried out to determine the combined effect of acceleration voltage and incident beam orientation on the characteristic X-ray production in thin crystals. For $MgAl_2O_4$ it has been shown that the orientation dependence undergoes a reversal in character above a particular voltage, which is referred to now as the 'inversion' voltage. This inversion voltage has been experimentally determined to be approx. 270 kV for $MgAl_2O_4$ compounds with a spinel structure and is in agreement with theoretical predictions based on a highly localized scattering model for characteristic X-ray production in thin crystals. Further, in combination with theoretical calculations, this 'inversion voltage' behaviour has been shown to be different from the conventional critical voltage effect. From the microanalysis point of view, it has been experimentally shown that in order to obtain an analysis independent of the incident beam orientation or the acceleration voltage, it is essential to systematically tilt the crystal to an orientation at which no lower-order Bragg reflections are excited.

6642 **Width of the electron loss to continuum cusp for He^+ colliding with He.** Burgdoerfer, J. (Tennessee Univ., Knoxville, USA. Dept. of Physics and Astronomy; Oak Ridge National Lab., TN, USA). *Journal of Physics B: Atomic and Molecular Physics;* **19**: No. 4, 417-419(28 Feb 1986). Contract AC05-84OR21400.

The width GAMMA of the electron loss of the continuum (ELC) cusp for He^+ colliding with He is calculated using the Born approximation. Good agreement is found with the recent data of other workers.

6643 **On the plasma polarization shift.** Cooper, J.; Kelleher, D.E.; Lee, R.W. (Joint Institute for Lab. Astrophysics, Univ. of Colorado and National Bureau of Standards, and Dept. of Physics, Univ. of Colorado, Boulder, CO 80309). pp 350-384 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Possible shifts of spectral ion-lines due to a nonzero mean field, <V>, in a plasma are considered. It is concluded that, in general, it is not consistent to add a <V> term to a "unified" or impact theory collision operator. In fact, the correct evaluation of the usual "shift-width" operator using quasiparticle interaction potentials (including the monopole term from collisions which penetrate the bound orbit of the radiator) and hyperbolic trajectories (or equivalent perturber wave functions) includes the major portion of the shift. According to the author's analysis, the use of the complete <V> as the shift is only justified when all collisional interactions of second order (and higher) in V are negligible.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 6643, 6910, 6911

6644 (AD-A—184173/3/XAB) Plasma thruster development. Final report, October 1984-September 1986. Schrade, H.O.; Auweter-Kurtz, M.; Kurtz, H.L.; Merke, W.D.; Sleziona, P.C. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Raumfahrtantriebe). Jul 1987. 121p. (IRS—87-P-10). NTIS, PC A06/MF A01.

Despite the present great lead of ion engines in development level, performance, and life for sizes up to several kW, new interest in magnetoplasmadynamic thrusters for higher power levels (up to hundreds of kW) has arisen in recent years. Mission studies showed specific-impulse values between 1000 and 2000 s for orbit raising and orbit transfers for optimized mass savings and trip times, and advantages for MPD propulsion even with relatively low efficiencies. With the probable realization of the SP-100 nuclear space power plant, sufficient power would also be available for steady state MPD propulsion, so that the benefits of these thrusters versus pulsed ones could be utilized; i.e., the ruggedness and simplicity of power and propellant conditioning and the about 3 orders of magnitude smaller cathode erosion. But there are also disadvantages of steady-state thrusters; e.g., with quasi-steady ones (but with other geometries) the achieved efficiencies and specific impulses were in some higher. The research work covered in this report deals with these and related problems: in chapter two, the experimental results with nozzle-type and cylindrical thrusters are presented. The influence of cathode position, ambient pressure, anode gas injection and propellant type on the performance is investigated. The thruster design studies and the heat transfer calculations for the MPD thruster with a radiation-cooled anode are reported.

6645 (N—87-27129) Computational fluid dynamics and aerothermodynamics. Semiannual progress report, January-June 1987. Carlson, L.A. (Texas A and M Univ., College Station (USA)). Jul 1987. 38p. (NASA-CR—181111; NAS—1.26:181111; TAMRF—5671-87-01). NTIS, PC A03/MF A01.

At the present time the efforts on this project are organized into two areas: the development of an approximate stagnation point solution and approximate flowfield studies which can be used to develop and investigate shock jump, electron temperature, radiation, vibration-dissociation coupling, and chemistry models. Progress in each area is discussed.

6646 (OUP—87-23) Light scattering study of physical properties of liquids. Bohidar, H.; Joessang, T.; Feder, J. (Oslo Univ. (Norway). Fysisk Inst.). Jul 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750371/JAW.

A multi-pass piezo-electric scanned Fabry-Perot interferometer has been used to perform Brillouin scattering experiments from a set of 8-single component liquids. This set was composed of associated, non-associated and viscous liquids. The deconvoluted spectra of the scattered light have been analysed to obtain the velocity, amplitude attenuation coefficient and lifetime of thermally generated longitudinal hypersonic density fluctuations (sound waves). Further, the Landau-Placzek ratio and the adiabatic and iso-thermal compressibility of these liquids have been determined. From the knowledge of the amplitude attenuation coefficient the typical distance traversed by the hypersonic sound wave in the medium before the dissipation of its energy has been calculated. 22 refs.

6647 (SAND—87-2101) Programs for calculating transient Darcian flow through non-uniform materials. Banister, J.R. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001924/JAW.

Several programs were developed for calculating the flow of high pressure gases into porous material. Some of these programs should be of general interest, so they are presented in this report. A general format for numerically integrating the second order differential equation is first developed; various modifications are then made to allow both spatial and time variations of the specific permeability and/or porosity of the medium. The accuracy of the programs was checked by integrating to steady state solutions which can be specified analytically. Small time steps must be used to avoid numerical instabilities; a method for increasing this time step in the later stages of the calculation was developed. 3 refs., 14 figs., 4 tabs.

6648 (UCRL—97344) Chaotic dynamics in dense fluids. Posch, H.A.; Hoover, W.G. (Vienna Univ. (Austria). Inst. fuer Experimentalphysik; Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 4p. (CONF-8709182—1). NTIS, PC A02. Order Number DE88002453/JAW.

From Physics of fluids conference; Calabria, Italy (22 Sep 1987).

We present calculations of the full spectra of Lyapunov exponents for 8- and 32-particle systems with periodic boundary conditions and interacting with the repulsive part of a Lennard-Jones potential both in equilibrium and nonequilibrium steady states. Lyapunov characteristic exponents λ/sub n/ describe the mean exponential rates of divergence and convergence of neighbouring trajectories in phase-space. They are useful in characterizing the stochastic properties of a dynamical system. A new algorithm for their calculation is presented which incorporates ideas from control theory and constraint nonequilibrium molecular dynamics. 4 refs., 1 fig.

6649 (UCRL—97532) Inferences drawn from shock-enhanced turbulent mixing analyses. Buckingham, A.C. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 9p. (CONF-8710192—1). NTIS, PC A02. Order Number DE88001634/JAW.

From Nuclear explosives design physics conference; Los Alamos, NM, USA (19 Oct 1987).

This discussion concerns analyses of physical shock-tube and shock-boundary layer interaction experiments, supplemented by computations. The basic issue is that of evaluating the influence of reflected shock waves on enhancing the balance of turbulent kinetic energy and resultant turbulent materials mixing during implosion and shock reflection intervals. Increases in random velocity amplitudes of a factor of 5 or greater implying turbulent kinetic energy increases of a factor of 12 or more have been observed in some low Mach Number shock-tube and boundary-layer shock wave interaction experiments. These results are analyzed to estimate their influence on increased turbulent material mixing subsequent to shock interaction. The analyses are developed with the assistance of two-dimensional, pseudospectral free turbulent field shock interaction numerical simulations as well as compressible turbulent boundary-layer shock interaction calculations. Of particular interest is the influence of Mach Number and pre-existing turbulent intensity on the enhancement ratios. 24 refs., 8 figs.

6650 Smooth particle hydrodynamics: Theory and application to the origin of the moon. Benz, W. (Los Alamos National Lab., Los Alamos, NM 87544). pp 117-124 of The use of supercomputers in stellar dynamics. Hut, P.; Mc Millan, S. New York, NY; Springer-Verlag New York Inc. (1986). (CONF-8606175—).

From Workshop on the use of supercomputers in stellar dynamics; Princeton, NJ, USA (2 Jun 1986).

Some may wonder what the origin of the moon has to do in a workshop on the use of supercomputer in stellar dynamics. The author shows that there is more in common between both than just the use of supercomputers. If one uses the so-called smooth particle hydrodynamics (SPH) method which substitutes for the fluid a finite set of extended particles, the hydrodynamics equations reduce to the equations of motion of individual particles. These equations of motion differ only from the standard gravitational N-body problem insofar that pressure gradients and viscosity terms have to be added to the gradient of the potential to derive the forces between the particles. The numerical tools developed for "classical" N-body problems can therefore be readily applied to solve three-dimensional hydrodynamical problems. In this paper the author uses origin of the moon only as an example of an application of the SPH technique.

6651 **Electronic structure of clusters of atoms in a dense, low-temperature plasma.** Collins, L.A.; Merts, A.L. (Theoretical Div., Group T-4, MS B212, Los Alamos National Lab., Los Alamos, NM 87545). pp 385-422 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

The authors consider as a model for a dense plasma at normal solid densities (10/sup 22/ - 10/sup 25/ atoms/cm/sup 3/) and low temperature (T ≦ 50 eV) a cluster of N mutually interacting atoms of a given species. They make the Born-Oppenheimer approximation in order to separate the electronic and nuclear motion and perform electronic structure calculations on such a cluster by the Extended Huckel method in order to obtain the band widths as a function of interatomic separation or compression. Electronic band widths are typically converged for cluster sizes of the order of 100 atoms, a size that also agrees with the observed short-range order of other disordered systems such as liquids or glasses. The model has some features in common with the standard quasistatic approach to line broadening; however, one striking difference is that the cluster model predicts a width to a line even at T = O°K. Studies have been performed for Na, Aiota, Cu, and Fe. Thermal motions for temperatures below 500°K produce little change in the band widths.

6652 **Angle-averaged compton cross sections.** Nickel, G.H. (Los Alamos National Lab.). pp 210-220 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

A simple and accurate analytical expression is presented for the Compton scattering cross section for a monoenergetic isotropic distribution of relativistic electrons. Computational models of plasmas in which Compton scattering is important need a rapid and accurate prescription for the Compton cross sections. While the Klein-Nishima formula is correct in the rest frame of the electron, the calculation of laboratory frame average cross sections for plasmas with relativistic electrons is relatively tedious. This work is relevant to P/sub n/ or S/sub n/ formations which require averages over all of the angles describing the scattering events. As an alternative approach, this paper provides an analytical scheme to compute accurate averages over the three collision angles using variable transformations to simplify the integrations. It is very accurate for electron velocities up to about one-half the speed of light.

6450 High Energy Physics

6653 **(CERN—87-07-Vol.1) Proceedings of the workshop on physics at future accelerators.** (European Organization for Nuclear Research, Geneva (Switzerland)). 4 Jun 1987. 360p. (CONF-870180—). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88700576/JAW.

From Workshop on physics at future accelerators; La Thuile, Italy (7 Jan 1987).

A workshop took place at La Thuile and at CERN in January 1987 to study the physics potential of three types of particle collider with energies in the TeV region, together with the feasibility of experiments with them. The machines were: A Large Hadron Collider (LHC) placed in the LEP tunnel at CERN, with a total proton-proton centre-of-mass energy of about 16 TeV; an electron-proton collider, using the LHC and LEP, with a centre-of-mass energy in the range 1.3 TeV to 1.8 TeV; and an electron-positron linear collider with centre-of-mass energy about 2 TeV. This volume of the proceedings contains summary talks given at CERN by the conveners of the study groups. They cover the possibilities for discovery of new phenomena anticipated in the energy region up to the order of a TeV in the centre of mass of colliding partons, or of the electron and positron. Also discussed are the limits of current technology in the construction of particle-detector systems suitable for use at these energies, and especially in the high event rates provided by a proton-proton collider of luminosity 10/sup 33/ cm/sup -2/ s/sup -1/ or more.

6654 **(DOE/ER—0353) Summaries of research in high energy physics.** (USDOE Office of Energy Research, Washington, DC. High Energy Physics Div.). Nov 1987. 353p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88002816/JAW.

The compilation of summaries of research and technology R and D efforts contained in this volume is intended to present a detailed narrative description of the scope and nature of the HEP activities funded by the Department of Energy in the FY 1985/FY 1986 time period. Topic areas covered include the following: experimental research using the accelerators and particle detector facilities and other related research; theoretical research; conception, design, construction, and operation of particle accelerators and detectors facilities; and research and development programs intended to advance accelerator technology, particle detector technology, and data analysis capabilities.

6655 **(LA—11124-PR) Physics Division progress report, January 1, 1984-September 30, 1986.** Keller, W.E. (comp.). (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88002998/JAW.

This report provides brief accounts of significant progress in development activities and research results achieved by Physics Division personnel during the period January 1, 1984, through September 31, 1986. These efforts are representative of the three main areas of experimental research and development in which the Physics Division serves Los Alamos National Laboratory's and the Nation's needs in defense and basic sciences: (1) defense physics, including the development of diagnostic methods for weapons tests, weapon-related high-energy-density physics, and programs supporting the Strategic Defense Initiative; (2) laser physics and applications, especially to high-density plasmas; and (3) fundamental research in nuclear and particle physics, condensed-matter physics, and biophysics. Throughout the report, emphasis is placed on the design, construction, and application of a variety of advanced, often unique, instruments and instrument systems that maintain the Division's position at the leading edge of research and development in the specific fields germane to its mission. A sampling of experimental systems of particular interest would include the relativistic electron-beam accelerator and its applications to high-energy-density plasmas; pulsed-power facilities; directed energy weapon devices such as free-electron lasers and neutral-particle-beam accelerators; high-intensity ultraviolet and x-ray beam lines at the National Synchrotron Light Source (at Brookhaven National Laboratory); the Aurora KrF ultraviolet laser system for projected use as an inertial fusion driver; antiproton physics facility at CERN; and several beam developments at the Los Alamos Meson Physics Facility for studying nuclear, condensed-matter, and biological physics, highlighted by progress in establishing the Los Alamos Neutron Scattering Center.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 6290, 6726

6656 **(BNL—40386) Status and first results of Brookhaven Experiment 780: A search for K/sub L//sup 0/ → mu + e and K/sub L//sup 0/ → e + e.** Greenlee, H.B.; Kasha, H.; Mannelli, E.; Mannelli, M.; Schaffner, S.; Schmidt, M.P.; Schwarz, C.B.; Adair, R.K.; Jastrzembski, E.; Larsen, R.C. (Brookhaven National Lab., Upton, NY (USA); Yale Univ., New Haven, CT (USA). Dept. of Physics). 1 Oct 1987. Contract AC02-76CH00016. 18p. (CONF-870821—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002631/JAW.

From SLAC summer institute on particle physics; Stanford, CA, USA (10 Aug 1987).

We report on the progress of a search for the rare decays K/sub L/^{0} → μ + e and K/sub L/^{0} → e + e underway at the Brookhaven National Laboratory AGS. Analysis of data collected

in February and May of 1987 yields the preliminary limit: BR(K/sub L/^{0} → μ + e), BR(K/sub L/^{0} → e + e) < 7 x 10^{-9}. Prospects are discussed for the running period scheduled to begin in January of 1988.

6657 (CALT—63-440) Neutrino oscillation experiments. Boehm, F. (California Inst. of Tech., Pasadena (USA)). 1985. Contract AS03-81ER40002. 15p. (CONF-8506178—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002290/JAW.

From Cretan international meeting on subatomic physics; Crete, Greece (23 Jun 1985).

We review the results of neutrino oscillation experiments at reactors and at high energy accelerators. To date there is no convincing evidence for neutrino oscillations, and thus of finite neutrino mass or neutrino mixing. Upper limits of both mass parameters and mixing angles are presented. 16 refs., 12 figs.

6658 (CERN-EP—86-111) Recent results in deep inelastic scattering. Sloan, T. (European Organization for Nuclear Research, Geneva (Switzerland)). 13 Aug 1986. 22p. (CONF-8606203—11; CONF-8605200—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900102/JAW.

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

In this paper, developments in the field of deep inelastic scattering are discussed. Three areas, where recent data has been presented, will be covered: Exclusive or elastic rho^0, phi and J/psi production in deep inelastic muon production is described, i.e., the process μN → μVN, where V is a vector meson and N is a nucleon. The data indicate that at high Q^2 the vector dominance behavior of the photon dies away and the photon becomes a pure electromagnetic probe, even for the production of vector mesons; tests of the quark parton model of the nucleon and QCD from deep inelastic neutrino and muon scattering are described; and data on the differences between the structure functions of the nucleon bound in nuclei and those in free nucleons are reviewed. 35 refs., 12 figs.

6659 (CERN-EP—87-03) Experimental summary of proton-antiproton collider physics. Goldhaber, G. (Lawrence Berkeley Lab., CA (USA); European Organization for Nuclear Research, Geneva (Switzerland)). 6 Jan 1987. Contract AC03-76SF00098. 22p. (CONF-8606286—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000282/JAW.

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

This paper contains a summary talk on the experimental results of collision between protons and antiprotons. The particular events discussed are: the production and decay properties of the w and z, results of missing-energy events, muon and dimuon production, Quantum Chromodynamics tests, direct photon production in proton-antiproton collisions, pulsed-mode operation of the CERN proton-antiproton and future accelerator and detector developments and upgrades in progress. 4 refs. (LSP)

6660 (FNAL/C—87/142-E) A study of the semileptonic decay mode D^0 → K$^-$ e$^+$ nu/sub e/. Anjos, J.C.; Appel, J.A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Elliott, J.R.; Escobar, C.O.; Estabrooks, P.; Gibney, M.C.; Hartner, G.F. (California Univ., Santa Barbara (USA); Carleton Univ., Ottawa, Ontario (Canada); Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Colorado Univ., Boulder (USA); Fermi National Accelerator Lab., Batavia, IL (USA); National Research Council of Canada, Ottawa, Ontario). Sep 1987. Contract AC02-76CH03000. 11p. (CONF-870797—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002407/JAW.

From International symposium on lepton and photon interactions at high energies; Hamburg, F.R. Germany (27 Jul 1987).

We present an analysis of the exclusive semileptonic decay mode D^0 → K$^-$ e$^+$ nu/sub e/. We have measured the ratio of decay rates Γ(D^0 → K$^-$ e$^+$ nu/sub e/)/Γ(D^0 → K$^-$ π$^+$). After correcting for the reconstruction efficiencies and subtracting the contribution from other decay modes we have found the ratio to be equal to 0.77 +- 0.12(stat) +- 0.13(syst).

6661 (FNAL/C—87/143-E) A search for flavour changing neutral current processes in decays of charmed mesons. Anjos, J.C.; Appel, J.A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Elliott, J.R.; Escobar, C.O.; Estabrooks, P.; Gibney, M.C.; Hartner, G.E. (California Univ., Santa Barbara (USA); Carleton Univ., Ottawa, Ontario (Canada); Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Colorado Univ., Boulder (USA); Fermi National Accelerator Lab., Batavia, IL (USA); National Research Council of Canada, Ottawa, Ontario). Sep 1987. Contract AC02-76CH03000. 11p. (CONF-870797—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002406/JAW.

From International symposium on lepton and photon interactions at high energies; Hamburg, F.R. Germany (27 Jul 1987).

Neutral current interactions are known from studies of K meson decays to conserve flavor to a high precision. Although flavor changing neutral currents (FCNC) are forbidden in the Weinberg-Salam model, many extensions of the Standard Model allow such processes. We present preliminary upper limits on FCNC-mediated decays of charmed particles, namely D^0 → e$^+$ e$^-$, D^0 → μ$^+$ μ$^-$, D^0 → μe and D$^+$ → π$^+$ μe.

6662 (FNAL/Pub—87/125-E) Physics at √(s) = 2TeV: An experimentalist's perspective. Raja, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1987. Contract AC02-76CH03000. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002408/JAW.

This article is based on a series of 5 lectures delivered at the Mexican School. It is intended as an introduction to the physics expected at the Fermilab anti p p collider, the Tevatron, and as such relies heavily on its extrapolative power on physics done at lower energies at the CERN ISR and s anti p pa. The lectures were delivered to graduate students and, where possible, the author has attempted to give derivations of the basic formulae. The lectures deal with minimum bias physics, QCD jets, W/Z production, Heavy Flavor production and exotic phenomena beyond the standard model, and each subject is covered in some detail from the experimentalist's point of view. 119 refs., 81 figs.

6663 (IFVE-OEF—86-220) Study on the inclusive and semi-inclusive transverse momentum distributions of charged hadrons in p-barp interactions at 32 GeV/c. Bogolyubskij, M.Yu.; Borovikov, A.A.; Bumazhnov, V.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 18p. (In Russian). (SERP-E—138). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700631/JAW.

Submitted to the journal Sov. J.Nucl. Phys. .

Study of inclusive and semi-inclusive p/sup 2/ distributions of all charged particles, π/sup -/ mesons and antiprotons in p-barp interactions at 32 GeV/c is carried out and parameters of these distributions are determined. It is shown that the decrease of a mean transverse momentum of the π/sup -/ mesons with increase of chrged multiplicity n/sub ch/ is related with growth of probability for the particles to be produced with small p/sub T/. At the same time probability for the particles to be produced p/sub T/ >1 GeV/c is independent of n/sub ch/. A shape of inclusive p/sub T//sup 2/ distribution depends on the production mechanism of the hadrons with increaed p/sub T/ and on the dynamics of their compensation; specially p/sub T//sup 2/-distribution of the particles, emitted in the p/sub T/-plane at the angles smaller than 90 deg relatively to the hadron with maximal p/sub T/, has a maximal slope. 13 refs.; 7 figs.; 6 tabs.

6664 (IFVE-OEF—86-240) Quasi-elastic charge-exchange of negative pions into π/sup 0/, eta, eta'(958), ω(783) and f/sub 2/(1270) mesons on carbon at 39.1 GeV/c. Apokin, V.D.; Arestov, V.D.; Belikov, N.I. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 18p. (In Russian). (SERP-E—149). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700632/JAW.

Differential cross sections of charge exchange of π/sup -/ on carbon π/sup -/C -> M/sup 0/C* have been measured at 39.1 GeV/c with M/sup 0/=π/sup 0/, eta, eta'(958), ω(783) and f/sub 2/(1270) and the momentum transfers -t up to 3.0; 2.0; 1.0; 2.4 and 2.0 (GeV/c)/sup 2/ respectively. The t-dependence of the carbon "effective charge" Z/sub eff/(t) has been obtained in each reaction. The experimental results favour hypothesis of scattering of coloured cloud off nucleon in a nucleus. 11 refs.

6665 (IFVE-OEF—86-241) Z-dependence of differential and total cross sections in quasibinary charge-exhcange reactions on nucleiπ/sup -/A/sub z/ -> (π/sup 0/, eta, ω, f/sub 2/)+A/sub Z-1//sup :/ at 39.1 GeV/c. Apokin, V.D.; Arestov, Yu.I.; Belikov, N.I. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 16p. (In Russian). (SERP-E—149). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700633/JAW.

Z-dependences of the differential cross sections in the quasielastic charge-exchange reactions on nuclei π/sup -/A/sub Z/ -> M/sup 0/A/sub Z-1/* have been investigated at 39.1 GeV/c, with M/sup 0/=π/sup 0/, eta, ω and f/sub 2/ (1270), and A/sub Z/=H/sub 1/, C/sub 6/, Al/sub 13/, Cu/sub 29/, Sn/sub 50/, Pb/sub 82/. Z-dependences of the first exponential slopes of differential cross sections, t-dependencesof the effective nuclei charges and Z-dependences of total cross sections have been obtained. 2 refs.; 6 figs.

6666 (IFVE-ONF—86-222) μ/sup -/e/sup +/ - pair production in neutrino interactions on the SCAT bubble chamber. Ammosov, V.V.; Ivanilov, A.A.; Ivanov, P.V. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 11p. (In Russian). (SERP-E—107). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700640/JAW.

Submitted to the journal Zeit. Phys. C.

μ/sup -/e/sup +/ pair production in ν/sub μ/N interactions are studied in the bubble chamber SCAT experiment. The relative yield of μ/sup -/e/sup +/ pairs in charged current events above charmed particle production threshold is (4.6 +- 1.2)x10/sup -3/. The properties of μ/sup -/e/sup +/ events are satisfactorily described under assumption on their production from quasielastic production of Λ/sub c//sup +/-baryons and inclusive D-meson production. The relative yields of these reactions are (6.7 +- 3.5)x10/sup -2/ and (2.5 +- 0.9)x10/sup -2/ respectively. The total yield of charmed particles is (9.2 +- 3.6x10/sup -2/. 19 refs.; 3 figs.; 1 tab.

6667 (IFVE-ONF—86-224) Observation of muon internal bremsstrahlung in the ν/sub μ/A -> μ/sup -/X reaction. Grabosh, G.Yu.; Kaufmann, Kh.Kh.; Kreker, U. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). (SERP-E—107). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700641/JAW.

Submitted to the journal Yad. Fiz. .

A signal of muon internal bremsstrahlung has been selected in the neutrino experiment carried out on the bubble chamber SCAT when studying neutrino interaction with nucleons in charged current. The signal observed is related to the process, which makes a contribution to the radiative corrections for neutrino interaction cross section in charged current, and is well described in the framework of semiclassical approximation. 11 refs.; 6 figs.

6668 (IFVE-ONF—86-244) Study on the polarization effects in rho/sup 0/ meson production in quark jet o ν(nu-bar)N chaged current interactions. Ammosov, V.V.; Burtovoj, V.S.; Gapienko, V.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700642/JAW.

Submitted to the journal Yad. Fiz. .

The spin density matrix of the rho/sup 0/-meson have been studied in (anti)neutrino charged current induced quark jet, obtained with the Fermilab 15-foot bubble chamber. The rho/sup 0/-meson spin alignment is analysed in the helisity system and the rho/sup 0/ is found to be dominant in the helicity zero spin state (longitudinal polarization). The value of the rho/sup 0/-meson spin density matrix element rho/sub 00/ in this system is found to be 0.63+-0.15. P-odd matrix elements of rho/sup 0/ decay, which are directly sensitive to the quark polarization are investigated. These data may indicate to the observation possibility of the quark polarization effects. 21 refs.; 7 figs.

6669 (IFVE-OTF—86-44) On anomalous Z -> γll interaction. Komachenko, Yu.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700646/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Weak electromagnetic decays of Z- and W-bosons, caused by anomalous Z -> γll, W -> γlν interaction have been considered. The contribution from this interaction to the processes νe -> γ, νp -> $\nu\gamma$X has been taken into account. 22 refs.; 1 fig.

6670 (ITEF—91(1986)) Average multiplicities of secondary particles in the neutrino interaction with photoemulsion nuclei and neon. Vojvodik, L.; Smart, V.; Vajsenberg, A.O. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700682/JAW.

Results of comparative analysis of the average multiplicities of relativistic and strongly-ionized secondary particles resulting from the neutrino interaction with photoemulsion nuclei and neon in Fermilab (USA) 15-poot bubble chamber are presented. The results are in agreement with predictions of modified cascade model. By the growth of 4-momentum transferred to hadrons and of hadron system invariant mass a decrease of the average multiplicities of black and grey traces is observed. 21 refs.; 9 figs.; 3 tabs.

6671 (JINR—R-1-86-793) Cross sections of two-prong exclusive reactions in p-barp interactions at 22.4 GeV/c. Batyunya, B.V.; Boguslavskij, I.V.; Bruntsko, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700504/JAW.

Submitted to the Czechoslovak J. Phys. .

The results on the cross-section determination of some two-prong final states with one neutral particle (1C-fits) in p-barp-interactions at 22.4 GeV/c are presented. These results have been obtained from pictures of the hydrogen bubble chamber "Ludmila". The methodical problems of the reaction selection are presented the fulfilling of CP invariance of the channels is demonstrated and the energy behaviour of their cross sections is analysed. The obtained cross sections are: σ(p-barp -> p-barpπ/sup 0/)=1.4 +- 0.1/sub -0.3//sup +0.1/mb, σ(p-barp -> n-barpπ/sup -/)=0.8 +- 0.1 +- 0.1 mb, σ(p-barp -> p-barpπ/sup +/)=0.9 +- 0.1 +- 0.2 mb. The results show a diffractie character of these reactions. 12 refs.; 6 figs.; 2 tabs.

6672 **(JINR—R-1-86-839) Multiplicity distributions of charged particles in N-barp and np interactions and n-barp annihilation at 6.1 GeV/c.** Batyunya, B.V.; Boguslavskij, I.V.; Bruntsko, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700506/JAW.

Submitted to the journal Yad. Fiz. .

Topological cross sections and multiplicity distribution momenta of charged particles for n-barp and np-interactions at 6.1 GeV/c are presented. The data were extracted from the d-barp -> p-bar/sub s/+X and dp -> p/sub s/+X reactions. Based on G-invariance of the n-barp-interaction, the characteristics of the n-barp-annihilation have been directly determined and compared with values obtained by the difference method. Combined analysis of the n-barp/sub a/-, p-barp/sub a/- and n-barp/sub a/-data at 6.1 GeV/c shows that annihilation processes make up about 40% of the total inelastic cross sections for all this isospin states. The experimental data also indicate that the following relation takes place: $\Delta\sigma$(n-barp) < σ/sub a/(n-barp)=σ/sub a/(p-barp) < $\Delta\sigma$(p-barp) which appears in a number of theoretical schemes. 19 refs.

6673 **(JINR—R-4-86-695) Investigations with antiprotons at LEAR facility.** Sapozhnikov, M.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 20p. (In Russian). (CONF-8610352—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700523/JAW.

From 3. All-Union school on few-particle and quark-hadron systems; Palanga, USSR (1 Oct 1986).

Experimental results on the investigation of low energy antiproton interaction at LEAR facility at CERN are discussed. Status of the experimental searches for the resonances and bound states in N-barN system is described. The outline of physical program of the future LEAR experiments is given. 56 refs.; 6 figs.; 5 tabs.

6674 **(JINR-R—1-86-626) Evidence for existence of a possible stable dibaryon.** Shakhbazyan, B.A.; Kechechyan, A.O.; Tarasov, A.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700708/JAW.

Submitted to the journal Zeitschrift Phys. C.

A search for H dibaryon was undertaken in the mass range from a neutron double mass up to invariant masses M/sub $\Lambda\Lambda$/. In the proton-propane interactions at 10 GeV/c one V/sup 0/ particle has been found satisfying the kinematics of slow decay H -> Σ/sup -/+p only. The mass of the event treated as H -> Σ/sup -/+p appeared to be (2173.94+-1.32) MeV/c/sup 2/, its lifetime being 0.668x10/sup -10/ s, production cross section 40 nb. It is shown that this event satisfies the kinematics of production reaction on an intranuclear fluctuon of deuterium mass pd -> HpK/sup +/K/sup 0/. In neutron-propane interactions at 7.0 GeV/c an event has been found satisfying the conversion kinematics of the H dibaryon of the same mass 2173.94 MeV/c/sup 2/ into two Λ hyperons: Hp -> $\Lambda\Lambda$p. The effective cross section of the two-step H-production conversion reaction is estimated to be 228 nb. This means that the H-conversion cross section is much larger than the H production one. 44 refs.; 5 figs.; 7 tabs.

6675 **(JINR-R—1-86-721) Characteristics of secondary particles produced in π/sup -/C interactions at 40 GeV/c as a function of target mass.** Ivanovskaya, I.A.; Togoo, R.; Cheplakov, A.P.; Baatar, Ts.; Sehrdamba, L.; Tuvdendorzh, D.; Tsehrehn, D. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of High Energy; AN MNR, Ulan-Bator. Inst. Fiziki i Tekhniki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700711/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The characteristics of secondary particles produced in π/sup -/C interactions at 40 GeV/c (momenta, emission angles, rapidities) are analysed as a function of target mass. It is shown that for cumulative particles these characteristics do not depend on the target mass. The average multiplicity of secondary charged pions and the average transverse momenta squared of π/sup -/ mesons and protons are studied depending on the total energy squared in the c.m.s. The experimental dependences are in good agreement with quantum chromodynamics predictions. 14 refs.; 8 figs.; 1 tab.

6676 **(KFKI—1987-27/A) Universal description of inelastic and non(single)-diffractive multiplicity distributions in pp collisions at 250, 360 and 800 GeV/c.** Krasznovszky, S.; Wagner, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700728/JAW.

A distribution function is proposed for multiplicity in accordance with the stochastic number evolution. This function gives a universal description of inelastic and nondiffractive multiplicity distributions in pp collisions at 250, 360 and 800 GeV/c. The negative binomial distribution fails in the description of inelastic data. 14 refs.; 4 tables

6677 **(SLAC-PUB—4449) Crystal Ball results on tau decays.** Lowe, S.T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 6p. (CONF-8709147—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002560/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

This report reviews measurements and upper limit determinations for a number of exclusive 1-prong tau decay modes using the Crystal Ball detector. These results are important input to the apparent discrepancy between the topological and sum-of-exclusive branching fractions in 1-prong tau decays.

6678 **Neutral decays of eta'(958).** Alde, D.; Knapp, E.A.; Binon, F.G.; Bricman, C.; Lagnaux, J.P.; Mouthuy, T.; Stroot, J.P.; Donskov, S.V.; Inyakin, A.V.; Kachanov, V.A. (Los Alamos National Lab., NM, USA; Institut Interuniversitaire des Sciences Nucleaires, Brussels, Belgium). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **36**: No. 4, 603-609(Nov 1987). (In English).

The partial widths of the eta'(958) decays into 2γ, $\omega\gamma$, 3π/sup 0/ and etaπ/sup 0/π/sup 0/ have been measured with the GAMS-2000 spectrometer at the 70 GeV IHEP accelerator. Upper limits for the eta' decays into 3γ, π/sup 0/$\gamma\gamma$, 2π/sup 0/ and 4π/sup 0/ have also been obtained. The slope of a linear matrix element for the G-parity violating decay eta' -> 3π/sup 0/ has been determined.

6679 **Tagging diquarks by protons of high transverse momentum in pp collisions at the ISR.** Breakstone, A.; Crawley, H.B.; Firestone, A.; Gorbics, M.; Isenhower, D.; Lamsa, J.W.; Meyer, W.T.; Campanini, R.; Cuffiani, M.; Deninno, M.M. (Ames Lab., IA, USA; Iowa State Univ. of Science and Technology, Ames, USA. Dept. of Physics). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **36**: No. 4, 567-576(Nov 1987). Contract W-7405-ENG-82;AC03-76SF00098.

Events are analyzed in which a high transverse momentum proton was produced at polar angles of 10/sup 0/, 20/sup 0/ and 45/sup 0/. The experiment was performed with the split field magnet detector at the CERN ISR at $\sqrt{s}$=62 GeV. A 4-jet structure of these events is found. The measured charge structure of spectator jets is compatible with proton production from hard diquark scattering. This is supported by a study of baryon number compensation in the towards jets. The observed charge compensation in the towards jets suggests dominance of hard (ud) scattering. Evidence for Δ/sup ++/ production at high transverse momentum indicates the presence of an additional (uu) scattering component. The properties of the recoiling away jets are compatible with the fragmentation of a valence quark and/or of a gluon as in the case of meson triggers.

6680 **Search for heavy neutrino decays in a neutrino beam.** Ahrens, L.A.; Aronson, S.H.; Gibbard, B.G.; Murtagh, M.J.; White, D.H.; Callas, J.L.; Cutts, D.; Diwan, M.; Hoftun, J.S.; Lanou, R.E. (Brookhaven National Lab., Upton, NY, USA. Physics Dept.; Brown Univ., Providence, RI, USA. Dept. of Physics). *Physics Letters [Section] B;* **194**: No. 4, 586-590(20 Aug 1987). (In English).

A search has been made for the decays of heavy (≈ 200-500 MeV/c/sup 2/) neutrinos, ν/sub H/ -> νμe, in a 23 m long detector, in the wide-band neutrino beam at the Brookhaven AGS. No significant excess of such events was found and limits are set on the neutrino mixing matrix elements, vertical strokeU/sub eH/vertical stroke/sup 2/ and vertical strokeU/sub μH/vertical stroke/sup 2/. Results of a more general search for anomalous μe events are also reported.

6681 **Search for neutrino oscillations in the appearance mode ν/sub μ/ -> ν/sub e/ for neutrino energies near the muon threshold.** Dombeck, T.; Bowles, T.J.; Brown, A.; Brown, R.E.; Burman, R.L.; Clark, D.; Clearwater, S.; Kruse, H.; Lee, D.; Aas, B. (Los Alamos National Lab., NM, USA). *Physics Letters [Section] B;* **194**: No. 4, 591-596(20 Aug 1987). (In English).

A search for neutrino oscillations in the appearance mode ν/sub μ/ -> ν/sub e/ was performed using the in-flight pion-decay neutrino source at the LAMPF accelerator. An all-active scintillator detector was exposed to a muon-neutrino beam produced by five Coulombs of 800 MeV protons on target. Oscillation events would have appeared as high-energy electrons from the reaction ν/sub e/+C -> e/sup -/+X. We also measured charged-current muon events in the detector to normalize our results. Our data show no evidence for neutrino oscillations and we place 90% CL upper limits on $\sin^2(2\theta) < 0.008$ at $\Delta m^2 = 11$ eV/sup 2/, and $\Delta m^2 < 0.67$ eV/sup 2/ for complete mixing.

6682 **Progress report on the measurement of epsilon-c'/epsilon-c at Fermilab.** Bock, G.J.; Cabeza, P.; Coleman, R.; Daudin, R.; Debu, P.; Gung, M.; Gollin, G.; Grazer, G.; Hsiung, Y.; Jarry, P. (Fermilab, Batavia, IL 60510). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1004-1010(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

An ongoing experiment at Fermilab intends to measure the ratio of the CP violation parameters epsilon-c'/epsilon-c to a precision of .001. The experimental technique and apparatus are described. Sources of systematic error are discussed and some preliminary data from the test run in 1985 is shown. The status of the analysis is described and plans for the upcoming final data run in March 1987 are given.

6683 **Recent MARK III results on J/psi hadronic and radiative decays.** Lockman, W.S. (Institute for Particle Physics, University of California, Santa Cruz, California 95064). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 776-788(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Recent results from the MARK III experiment on J/psi radiative and hadronic decays are presented, based on an analysis of 5.8 x 10^6 J/psi decays collected at the SPEAR e^+e^- storage ring. The status of the ξ(2230) is reviewed and the result of a search for a new rare decay mode of the ξ(2230) is presented. The complete set of eta/sub c/ → $1^{--}1^{--}$ decays is discussed. In this channel, the eta/sub c/ decays preferentially to final states containing strange quarks. In the decays J/psi → {γ, ω, phi}X, X = {KK-bar, ππ, KK-barπ, etaππ}, J/psi → K*Kπ and J/psi → rhoetaπ, the vector mesons are used to probe the quark content of the recoil system. Possible evidence for θ(1720), but no indication for the iota(1460) is seen in these final states.

6684 **Physics at the Tevatron.** Lederman, L.M. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 33-46 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author reports on the "new resonance at 472 GeV." The topic of this paper is discussed into four subjects: SAVER - Key to the Tevatron, Fixed Target Program, Antiproton Source and Colliding Beam Detectors.

6685 **A magnetic monopole detector using superconducting sheet to trap the magnetic charge.** Wipf, S.L. (Los Alamos National Lab.). pp 386 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A desirable monopole detector should be specific to its size, be inexpensive to build and to monitor. It should detect the monopole's magnetic charge g (which is the only definitive quality of a monopole) and it should fix the record for subsequent re-examination. The proposed detector is formed of two concentric superconducting cylinders. Between the cylinders a superconducting detector loop can be rotated around the cylinder axis. A stationary SQUID, magnetically coupled to the loop, detects flux changes in the loop to a fraction of PHIo. After passage of a monopole the loop will, during one rotation, register changes of twice +g and twice -g as it passes the entry and exist points of the monopole. Thus the direction of the monopole path is also given. A single detector could have a size of 20 m/sup 2/sr.

6686 **Particle physics - Recent successes and future prospects.** Wojcicki, S. (Physics Dept. and Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 16-26 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—). Contract AC03-76SF00515.

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The situation in particle physics today is highly analogous to that which existed in chemistry towards the end of the 19th century. During the preceding two centuries, remarkable progress has been achieved in that discipline, progress that culminated in the periodic table of Mendeleyev. This paper summarized not only the realization that the everyday matter is composed of basic building blocks, called elements, but also that these different elements had certain similarities which could be used to properly arrange them in the periodic table. Thus the inert gases (helium, neon, argon, etc.) had very similar chemical properties, namely chemical inertness; the halogens (chlorine, iodine, florine) on the other hand were highly reactive. Other similarities were seen among the rare earth group of elements, alkaline earths, and alkali metals. In this paper the author attempts to summarize briefly the historical background that led us to the present level of understanding, or more specifically to the "standard model" of particle physics. He also describes several difficulties with this picture, continues with some possible indications of new physics, and finally end with the discussion of the prospects for the future.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 6290, 6658, 6746, 6761

6687 **(CERN—87-08) ECFA workshop on LEP 200. Vol. 1 and 2. Proceedings.** Boehm, A.; Hoogland, W. (eds.). (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Jun 1987. 520p. (ECFA—87/108; CONF-8609223—). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88700577/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

On the initiative of the European Committee for Future Accelerators, a workshop was organized to study experimental and theoretical aspects of the physics feasible at LEP with the beam

energy increased to its design value of 100 GeV per beam. These two volumes provide the written versions of the reports presented by nine working groups to the workshop, as well as the presentations on the machine upgrade itself and the potential of hadron colliders and of HERA for LEP 200 physics. Each working group studied a specific topic, evaluating in some detail the requirements both for the detectors and for the machine of W mass measurements, W decay properties, W production dynamics, electroweak radiative corrections, two-photon physics, new heavy quarks and leptons, Higgs particles, supersymmetric particles, and composite models. The proceedings also include some of the more detailed work done in the framework of the working groups.

6688 **(IFT-P—09/87) Stellar energy loss and anomalous contributions to γγ -> υ υ-bar.** Natale, A.A.; Pleitez, V.; Tacla, A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700618/JAW.

The stellar energy loss rate for several anomalous contributions to γγ υ υ-bar and for massive neutrinos is computed, except from the cases where the mass scale of these new contributions is very small, or the neutrino masses are very large, these reactions are not importants stellar energy loss mechanics.

6689 **(IFUSP-P—593) Color dielectric parameter in 2+1 dimensional QCD.** Brandt, F.T.; Frenkel, J. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700624/JAW.

A study of the color dielectric parameter ϵ in 2+1 dimensional QCD is described, based on the Schwinger-Dyson equations. With the help of the Ward identities in the axial gauge, it is concluded that ϵ(q/sup 2/) displays a (q/sup 2/)/sup -1/2/ singularity in the infrared limit. This behaviour yields confinement of color charges via constant chromoeletric fields at large distances.

6690 **(IFUSP-P—598) On the equivalence between the thirring model and a derivative coupling model.** Gomes, M.; Silva, A.J. da. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jul 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700628/JAW.

The equivalence between the Thirring model and the fermionic sector of the theory of a Dirac field interacting via derivate coupling with two boson fields is analysed. For a certain choice of the parameters the two models have the same fermionic Green functions.

6691 **(IFVE-OTF—86-7) Infrared singularities, chiral symmetry dynamical breaking and CP parity in quantum chromodynamics.** Kulikov, A.V.; Nekrasov, M.L.; Rochev, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700644/JAW.

Submitted to the journal Teor. Mat. Fiz. .

The problem of CP violation by the topological structure of QCD vacuum is solved in the framework of the model with the dynamical breaking of a chiral symmetry by infrared singularities. 11 refs.

6692 **(IFVE-OTF—86-11) Charm production in the DTU model.** Batunin, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700645/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The open and hidden charm hadroproduction has been produced to the SPS energies in the framework of the dual parton model. The free parameter λ/sub c/, the suppression of the charmed sea, comes from the experiments on the D-meson hadroproduction. Then the hidden charm production data are described assuming that the J/PSI-meson production suggests only one cc-bar-pair, while the pair PSIPSI-production suggests two cc-bar-pairs in the string. 13 refs.; 2 figs.; 1 tab.

6693 **(IFVE-OTF—86-22) QCD infrared region and calculation of gluon condenssates.** Arbuzov, B.A.; Boos, E.E.; Kurennoj, S.S.; Turashvili, K.Sh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700764/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

A method has been proposed to calculate the vacuum expectation values (VEV). It is shown that the nontriviality of these VEV is connected with the presence of a dimensional parameter k/sub 0//sup 2/ in QCD, which separates the Euclidean region for virtual momenta into regions k/sub i//sup 2/ < k/sub 0//sup 2/, where the perturbative theory method is valid and into k/sub i//sup 2/ < k/sub 0//sup 2/, where it does not hold. Using the explicit forms of the asymptotics of the Green functions in the infrared region (k/sub i//sup 2/ < k/sub 0//sup 2/) VEV <G/sup 2/> and <G/sup 3/> are calculated whose numeracal values agree with the phenomenological values, and for VEV <G/sup 4>/ a theoretical value is given, which predicts the violation of the hypothesis of factorization. 21 refs.

6694 **(IFVE-OTF—86-98) Radiative method to test Yang-Mills couplings.** Larin, V.N.; Tikhonin, F.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700647/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz. .

Quite a simple way to check gauge boson couplings is proposed. An approximate analytical experessions for the cross section of the process e/sup +/e/sup -/ -> γνν has been obtained. This expression takes into account the W-boson magnetic moment and it approximates the exact cross section quite well up to $\sqrt{S} = 150$ GeV. 7 refs.; 1 fig.; 1 tab.

6695 **(IFVE-OTF—86-121) On spin-spin correlation parameter oscillations.** Troshin, S.M.; Tyurin, N.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700648/JAW.

The model developed previously to describe spin phenomena reproduces the energy dependence of A/sub nn/ parameter observed at the ZGS and AGS energies and fixed p/sub perpendicular/. 3 refs.; 1 fig.

6696 **(IFVE-OTF—86-235) Hadron spin in the string model.** Pron'ko, G.P.; Solov'ev, L.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700650/JAW.

The model of extended meson based on the theory of straightline relativistic string is considered. This model gives a natural explanation for spin of hadrons. Both the classical and quantum theory of straightline string are described. Adding to the picture the fundamental spin of quarks provides with that explanation of all the mesonic states belonging to the set of leading Regge trajectories. After the second quantization of the model the decay processes of all these mesons could be described. Briefly the new approach for quantization of the full relativistic string which is free from contradictions of the traditional approach and four-dimensional spacetime is discussed. Hence, the theory of relativistic string can serve as a realistic model for mesons containing the light quarks. 7 refs.; 2 figs.; 1 tab.

6697 **(INIS-BR—902) Cosmological implication of massive neutrinos in a horizontal model context.** Goldman, C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Apr 1985. 131p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700662/JAW.

An extended version of the Glashow-Weinberg-Salam model for the eletroweak interactions is studied in detail. It has an extra global horizontal symmetry, which allows the appearance of neutri-

no mass terms. The constraints imposed by the standard cosmological model were used to determine the allowed range of variations of the free parameters of this model. As applications, the solar neutrinos problem and the formation of large scale structures in the universe is studied.

6698 **(ITEP—1(1986)) Neutrino magnetic moment and time variation of solar neutrino flux.** Voloshin, M.B.; Vysotskij, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700687/JAW.

An explanation is proposed of a possible anticorrelation of the observed neutrino flux from the Sun with the solar activity due to the existance of the neutrino magnetic moment $\mu \sim (0.3\text{-}1)\times 10^{-10}\ \mu_B$, resulting in a partial flip of neutrino helicity during the flight through the magnetic field of the solar convective zone. 7 refs.

6699 **(ITEP—5(1986)) On the nonuniversality of the bag constant B and stability of dilambda.** Kondratyuk, L.A.; Krivoruchenko, M.I.; Shchepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700688/JAW.

It is shown that in the quark bag model with nonuniversal constant B the H dihyperon is above the ΛΛ threshold and therefore is not stable. Estimates of the magnitude of B for 6-quark systems are made using the data on the deuteron magnetic moment. 15 refs.; 1 tab.

6700 **(ITEP—14(1986)) On the electric dipole moment of neutrino.** Okun', L.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700690/JAW.

The discussion on the electric dipole moment of neutrino is given. The manifestations of the electric dipole moment of neutrino and of its magnetic moment are practically indistinguishable in the case of massless or very light neutrino. 3 refs.

6701 **(ITEP—17(1986)) Weak non-leptonic decays of charmed mesons in QCD sum rules.** Blok, B.Yu.; Shifman, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700691/JAW.

This work continues the efforts aimed at developing QCD-based framework for description of weak non-leptonic decays of charmed particles. The theoretical part of the sum rules for the corresponding amplitudes starting from the operator product expansion in Euclidean domain is calculated. 10 refs.; 6 figs.

6702 **(ITEP—19(1986)) Trace anomaly in QCD and processes with a light higgs boson.** Voloshin, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700692/JAW.

It is shown that amplitudes of certain low-energy processes with a light Higgs boson such as the decays eta' -> etaH PSI' -> PSIH, Y' -> YH, H -> $\gamma\gamma$ are determined by properties of the trace of the energy momentum tensor. In this analysis an important role is played by the trace anomaly. When the latter is taken into account the predictions for the decay rates are significantly modified with respect to those existing in the literature. In particular the rates of eta' -> etaH and H -> $\gamma\gamma$ come out suppressed while for the widths of the transitions PSI' -> PSIH, Y' -> YH experimentally testable predictions are derived. 29 refs.; 2 figs.

6703 **(ITEP—20(1986)) Electromagnetic properties of neutrino and possible semiannual variation cycle of the solar neutrino flux.** Okun', L.B.; Voloshin, M.B.; Vysotskij, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700693/JAW.

The existence of neutrino magnetic moment μ_ν or(and) electric dipole moment ϵ_ν of the order of $10^{-10}\ \mu_B$ would give rise to variations of the observed solar neutrino flux correlated with the magnetic activity of the Sun. In this case besides the overall 11-year period there should also exist in the years of maximal activity a semiannual variation cycle of the observed flux of boron neutrinos. The latter variations are caused by the existence of the equatorial "slit" in the toroidal magnetic field of the Sun and by inclination of the ecliptic to the solar equator. Neutrino flavor changing electromagnetic moments of the type μ_{ν} and ϵ_{ν} and possibilities of studying them with a large liquid argon νe-scattering detector are discussed. 14 refs.

6704 **(ITEP—22(1986)) Theory for Higgs boson search in Y-meson decay.** Losev, A.S.; Vysotskij, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700694/JAW.

Search for Higgs boson in Y-meson decay is considered. The problems on the H-boson small mass, the H boson interaction with quarks and H boson production in electromagnetic and hadronic decays of an Y-meson are discussed. 8 refs.; 1 fig.; 1 tab.

6705 **(ITEP—23(1986)) Structure functions of the deep inelastic scattering in the region of intermediate x in QCD.** Ioffe, B.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700695/JAW.

The errors of the author's preceding paper on the QCD calculation of structure functions of the deep-inelastic scattering in the region of intermediate x are corrected which result in a better agreement of the theory with experiment. 3 refs; 1 fig.

6706 **(ITEP—37(1986)) Weak non-leptonic decays of charmed mesons. Theory versus experiment.** Blok, B.Yu.; Shifman, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700696/JAW.

Within the framework of the method developed earlier partial decay rates of charmed mesons are calculated. Both, Cabibbo-allowed and suppressed channels are considered. An estimate for the ratio of D^+ and D^0 lifetimes is given. A puzzle is observed in the F meson decays: two-particle (and quasi two-particle) decay modes seem to be responsible only for $\sim$ 15% of the total width. 15 refs.; 5 figs.; 5 tabs.

6707 **(ITEP—53(1986)) Onse more on the wave functions of light mesons in QCD.** Gorskij, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700697/JAW.

Various approaches to determination of low-energy wave functions of light mesons are discussed. It is shown that the equations of motion are suitable when analyzing the applicability region of asymptotic regime for wave functions. It is argued that the twist 2 π-meson wave functions coincide neither with the asymptotic function nor with the Chernyak-Zhitnitsky model one. 11 refs.

6708 **(ITEP—67(1986)) Orbital excitations of baryons.** Kobzarev, I.; Kondratyuk, L.; Martem'yanov, B.; Shchepkin, M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700698/JAW.

In this paper the model of the rotating string for the description of orbital excitations of nonstrange baryons is discussed. The consideration of them as the oblong bags with quarks or diquarks at the ends of the string is carried out. It is emphasize that results do not depend on the quantitative features of the bag-like structure of the string. In the model with ls-coupling the spectrum of orbital baryon excitations is calculated. The model of rotating string with Thomas precession term for ls-coupling allows to identify the main part of baryon excitations. 15 refs.; 7 figs.

6709 **(ITEP—77(1986)) Observation of the charmed strange pseudovector meson cascade radiative decay.** Asratyan, A.E.; Fedotov, A.V.; Goritchev, P.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700699/JAW.

The antineutrino production and cadcade radiative decay of the charmed strange pseudovector meson are observed. The pseudovector and vector F meson masses are measured to be (2547+-60) MeV and (2123+-15) MeV, respectively. 5 refs.; 2 figs.; 1 tab.

6710 **(ITEP—83(1986)) Hierarchy of lifetimes of charmed and beautiful hadrons.** Shifman, M.A.; Voloshin, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700701/JAW.

Pre-asymptotic corrections to total hadronic widths of weak decays of charmed and beautiful hadrons are considered. The main emphasis is put on effects due to the spectator quark. The so called hybrid logarithms emerging from the domain of momenta R/sup -2/ <or approx. p/sup 2/ <or approx. m/sub Q//sup 2/ (R is the hadronic size, m/sub Q/ is the heavy quark mass) are taken into account, a new element of the analysis. For chamed hadrons the pre-asymptotic corrections are of order unity, and the corresponding estimates of non leptonic widths are of semiquantitative character. The hierarchy of hadronic widths for D, F mesons and Λ/sub c/, γ/sub c//sup (A)/, Ω/sub c/ baryons is establish. The lifetime of Ω/sub c//sup 0/ turns out to be the smallest. The difference in lifetimes of beautiful hadrons is predicted to be definitely less than a few percent. 19 refs.; 6 figs.

6711 **(ITEP—84(1986)) Spin in exclusive processes in the string /sup 3/P/sub 0/ model.** Levintov, I.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700702/JAW.

The QCD-string model of soft exclusive processes is considered taking into account quark spins. It is shown that annihilation of a wee qq-bar pair in the state /sup 3/P/sub 0/ in production of a colour string in intermediate state leads to a certain relation of elements of the amplitude M/sub 0/+iσ-vectorn-vectorM/sub 1/ which is defined by the geometrical structure of spherical functions V/sub 1,m/. It is also shown that the account of the Thomas spin-orbital interaction in the string potential gives a small contribution into M/sub 0,1/ logarithmically decreasing with energy. 17 refs.

6712 **(ITEP—88(1986)) Explicit formulae for one, two, three and four loop string amplitudes.** Morozov, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700703/JAW.

A set of explicit formulae for multi-loop diagrams in the firstly-quantized theory of closed-orientable strings is presented. 7 refs.; 2 figs.

6713 **(ITEP—132(1986)) Bag-model motivated NN potentials and the three-nucleon system.** Grach, I.L.; Narodetskij, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700704/JAW.

Few examples are presented of the short-range energy-dependent NN potentials derived in the quark compound bag model which satisfy the classical causality condition and show that for the radii of the NN interactions b=1.35-1.40 fm these potentials reproduce the trinucleon binding energy. 11 refs.; 6 figs.

6714 **(JINR—R-2-86-739) About the mechanism of charmed quark excitation in inclusive production of D-mesons.** Bednyakov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700511/JAW.

D-meson inclusive pp-production by hard QCD excitation of charmed sea quark (qc -> qc, gc -> gc) was investigated. Charmed mesons are produced through recombination of charmed quark with quarks from initial protons. The recombination process is described phenomenologically in the language of a modified recombination function which permits to take into consideration the whole C-quark kinematical interval. The probability of fragmentation of initial proton to a set of quarks necessary for production of charmed meson with the given quantum numbers is assigned by two-particle distribution functions. Free parameters have been determined from the data analysis. Two allowed channels of charmed meson production by excitation mechanism was considered in lowest charm quark sea approximation. It is demonstrated that the excitation mechanism permits to describe the shape of meson momentum spectrum as well as production mechanism (qq-bar -> cc-bar, gg -> cc-bar). Momentum spectra and invariant differential cross sections of pp-productions of D/sup 0/-, D-bar/sup 0/-, D/sup +/-, D/sup -/-mesons have been calculated, at √S=26 GeV and X/sub F/>0. The possibility of specific for excitation mechanism maximum in momentum spectrum at low X/sub F/ was stressed. 13 refs.; 4 figs.

6715 **(JINR—R-2-86-825) Gluon fusion in supersymmetric quantum chromodynamics.** Darbaidze, Ya.Z.; Merebashvili, Z.V.; Slepchenko, L.A.; Matveev, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700513/JAW.

Submitted to the journal Phys. Lett. and to the Organizing Komittee of the European conference on computer algebra, Leipzig, Jul 1987.

A cross section of gluon bremsstrahlung and scalar quark pair production in gluon fusion is calculated in the lowest a/sub s// sup 3/ order of SUSY QCD perturbation theory. The cross section is presened as a product of two factors one of which corresponds to Born scattering cross section, and the other is concerned with the "infrared" factor describing soft gluon radiation. Axial calibration is used. Calcultions were carried out using REDUCE analytical program. 8 refs.

6716 **(JINR—R-2-86-826) Peculiarities of measurements of generation region space dimensional of identical particles in different reference frames.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700514/JAW.

Submitted to the journal Yad. Fiz. .

Interpretation of experimental results on the investigation of dependence of space dimensions of identical pion generation region in pp interactions on the motion rate of reference frame is given. It is noted that the increase of longitudinal dimensions of this region with growing of the Lorentz factor goes due to the relativistic elongation of longitudinal dimensions of fast-moving objects. 6 refs.

6717 **(JINR-R—2-86-143) K -> 2π decays in the chiral quark loop model.** Volkov, M.K.; Ivanov, A.N.; Troitskaya, N.I. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics; Leningradskij Politekhnicheskij Inst., USSR). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700712/JAW.

Nonleptonic decays K -> 2π(K/sup +/ -> π+π/sup 0/, K/sup 0/ -> π/sup +/π/sup -/, K/sup 0/ -> π/sup 0/π/sup 0/) are considered. For describing weak interaction the effective Lagrangian has been obtained in the standard Kobayashi-Maskawa model with the account of QCD-corrections. The weak interaction effective Lagrangian takes the form of linear superposition of four-quark operators satisfying the selection rules: ΔS=1, Δl=1/2 and Δl=3/2 where S is a strangeness an l is an isospin. Four-quark operator low-energy matrix elements are calculated in the chiral quark-loop model (the CQL-model). The Δl=3/2 transition amplitudes are defined in CQL by quark contact diagrams only. The Δl=1/2 transition amplitudes are described by both contact and pole diagrams. Strengthening of Δl=1/2 transitions with respect to Δl=3/2 transitions is due to the ϵ (700) scalar meson exchange: Γ(K/sup +/ -> π/sup +/π/sup 0/)/sub th/ : Γ(K/sup 0/ -> π/sup +/π/sup -/)/sub th/=1:165 with Γ(K/sup +/ -> π/sup +/π/sup 0/)/sub exp/: Γ(K/sup 0/ -> π/sup +/π/sup -/)/sub exp/=1:224. 13 refs.; 2 figs.

6718 **(JINR-R—2-86-183) On criteria of a choice of cumulative meson production scheme. Qualitative composition of cumulative hadrons; analysis of characteristics of hadron jets; classification of cumulative processes.** Golubyatnikova, E.S.; Shmonin, V.L.; Kalinkin, B.N. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700714/JAW.

Submitted to the jornal Acta Phys. Pol. .

In addition to the established earlier criteria which are to be applied to theoretical schemes of cumulative meson production, two new criteria are considered. The first one requires the accordance between experiment and description of qualitative composition of cumulative mesons of different types. The second criterion requiers the correct reproduction of characteristics of cumulative hadron jets. It is shown that to the both criteria satisfy the mechanism that assumes the production, by an incident particle, of a hot hadron system decaying usually beyond the nucleus. The status of this process is analysed in the general picture of cumulative effects constructed in accordance with the hierarchy of space-time intervals characteristics of lepton-nucleus, hadron- and nucleus-nucleus interactions and of the nucleus "response" to fast processes occuring. 28 refs.; 2 figs.

6719 **(JINR-R—2-86-190) Polarization effects in the nucleon beam scattering on nucleons, moving transversally.** Golovin, B.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700715/JAW.

Submitted to the Organizing comittee of the 3. symposium Nucleon-nucleon and hadron-nuclear interactions at intermediate energies, Gatchina, Apr 1986 g. .

Polarisation effects of kinematic origin have been considered in elastic nucleon scattering on a moving target-nucleon. It is shown that at the scattering of a polarised beam on a non-polarized target the cross section of the scattering in the laboratory system depends not only on the beam polarization component which is normal to the scattering plane, as in the case with a fixed target, but also on its longitudinal component and the component in the scattering plane. In the non-polarized initial state polarization of the nucleon scattered on a moving target is oriented not only along the normal to the scattering plane, but can also have a longitudinal component and a component which is normal to the nucleon momentum and lies in the scattering plane. 3 refs.

6720 **(JINR-R—2-86-682) To problem of the existence of rho(1250).** Govorkov, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700716/JAW.

Submitted to the journal Pis'ma ZhEhTF.

Testing phenomenological models by recent experimental data on the ωπ-production in e/sup +/e/sup -/ - colliding beams it is concluded that these data do not at all exclude the existence of rho(1250) as the first radial excitation of rho meson. The connection of this problem with the one of existence of glueballs is remarked. 8 refs.

6721 **(KFKI—1987-37/A) Lepton -> lepton + photon decays and lepton g-2 factors in gauge theories.** Nagy, T.; Vecsernyes, P. (Roland Eoetvoes Univ., Budapest, Hungary. Inst. for Theoretical Physics; Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700732/JAW.

The one loop fermion-fermion-vector three-point functions, the amplitude for the lepton -> lepton + photon decays and the anomalous lepton magnetic moments are given in general gauge theories. The results can be used to get restrictions on fermion mixings and the masses of the intermediate bosons. Some superstring inspired E/sub 6/ grand unified theories are discussed briefly. 17 refs.; 5 figs.

6722 **(LPC—86-02) Prompt meson production at large P/sub T/.** Benayoun, M.; Leruste, P.; Narjoux, J.L.; Petronzio, R. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). 1986. 71p. (CERN-TH—4368). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750637/JAW.

We study the higher twist production mechanism of all s-wave quarkonia as well as the three lowest lying 2-gluon gluonia. After reviewing the basic notions which express the conditions under which perturbative QCD applies to prompt production, we work out all the differential cross sections of hard processes in which, aside from the prompt meson, there are either only partons (q, antiq, g) or partons and a single photon. After pointing out some general remarks about the properties of the higher twist mechanism which follow from these results, we give numerical evaluations of prompt production in itself and compare it with what is expected from the parton fragmentation picture alone. To this end, an extensive use is done of the lund high-P/sub T/ Monte Carlo as well as its modified versions which include the prompt production mechanism. Interesting channels are quoted, in hadron-hadron and photon-hadron scatterings, for which the higher twist signal is expected to be enhanced compared to the parton fragmentation background.

6723 **(LPC—86-25) Probing the pomeron's quark structure with virtual photons or vector bosons.** Arteaga-Romero, N.; Kessler, P.; Silva, J. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). Nov 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750638/JAW.

Following a suggestion of Ingelman and Schlein, we examine the possibility of investigating the pomeron's quark structure through a deep inelastic electroproduction measurement performed at an ep collider such as HERA, using a tagging device for protons scattered very close to 0/sup 0/ and with small relative energy loss.

6724 **(SLAC-PUB—4443) Flavor mixing with quarks and leptons.** Bigi, I.I. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 11p. (CONF-8708174—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002561/JAW.

From 7. international conference on physics in collision; Tsukuba, Japan (25 Aug 1987).

The last year has brought such a wealth of new information on heavy flavors that meaningful bounds can now be placed on all

fermion mass related parameters in the Standard Model. The status of the KM matrix is reviewed with particular emphasis on the theoretical uncertainties. B^0-anti B^0 mixing is reevaluated and CP violation is discussed as it is observed in K/sub L/ decays and as it hopefully can be studied in B decays. The report is concluded with short remarks on neutrino oscillations.

6725 **(SLAC-PUB—4451) Testing quantum chromodynamics in anti-proton reactions.** Brodsky, S.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 10p. (CONF-8709160—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002559/JAW.

From 4. LEAR workshop; Villars-sur-Ollon, Switzerland (6 Sep 1987).

An experimental program with anti-protons at intermediate energy can serve as an important testing ground for QCD. Detailed predictions for exclusive cross sections at large momentum transfer based on perturbative QCD and the QCD sum rule form of the proton distribution amplitude are available for anti p p $\rightarrow \gamma\gamma$ for both real and virtual photons. Meson-pair and lepton-pair final states also give sensitive tests of the theory. The production of charmed hadrons in exclusive anti p p channels may have a non-negligible cross section. Anti-proton interactions in a nucleus, particularly J/psi production, can play an important role in clarifying fundamental QCD issues, such as color transparency, critical length phenomena, and the validity of the reduced nuclear amplitude phenomenology.

6726 **(SLAC-PUB—4459) Using anti pp annihilation to find exotic mesons.** Sharpe, S.R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 10p. (CONF-8710125—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002558/JAW.

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

Present data suggests that a number of mesons have been found which cannot be accommodated in standard anti qq multiplets. Theory suggests that such exotic mesons should exist in the spectrum of Quantum Chromodynamics, but provides little guide to their properties. It is argued that a high luminosity, low energy anti pp machine would be a powerful tool with which to search for such exotics.

6727 **Physics of heavy-quark production in quantum chromodynamics.** Brodsky, S.J.; Gunion, J.F.; Soper, D.E. (Stanford Linear Accelerator Center, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2710-2728(1 Nov 1987). Contract AC03-76SF00515.

For very heavy quark masses, QCD predicts that the inclusive hadronic production of heavy quarks is governed by quark and gluon hard-scattering subprocesses. On general grounds, one expects corrections of order μ/M/sub Q/, where $\mu \sim 300$ MeV and M/sub Q/ is the heavy-quark mass. At the charm mass scale, such corrections could be important, possibly accounting for the anomalies observed in the nuclear-number dependence, the longitudinal-momentum distributions, and beam-flavor dependence of charm hadroproduction. In this paper we present a general overview of such corrections. In particular, we discuss a "coalescence" correction, which substantially alters the cross section in situations where the heavy quark is known to have a low velocity relative to one or more constituents of the spectator jet. In attractive channels the result is a large enhancement. In inclusive cross sections this final-state-interaction effect is suppressed by only a single power of the heavy-quark mass.

6728 **Hadron spectrum on an 18^3 x 42 lattice.** Gupta, R.; Guralnik, G.; Kilcup, G.; Patel, A.; Sharpe, S.R.; Warnock, T. (MS-B285, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2813-2827(1 Nov 1987). Contract AC02-76ER03130.

We present results for the hadron spectrum of quenched lattice QCD on an 18^3 x 42 lattice at $\beta = 6.2$. We compare r = (1/2 Wilson fermions with quark masses in the range m/sub q//m/sub s/ = 1 to 5 to staggered fermions with m/sub q//m/sub s/ = (1/3 to 2. In the overlap region we find that the spectra agree, and that both yield a/sup -1/$\cong$2.5 GeV, if we use m/sub rho/ to set the scale. We also find that the flavor symmetry of the staggered fermions is restored to a greater degree than at lower β. However, for both types of fermion, the nucleon to rho mass ratio comes out too high, never dipping below 1.5. We show the advantages to be gained with staggered fermions by using operators nonlocal in time. Using these operators we uncover a second problem: an anomalously light flavor-nonsinglet scalar. We also present results for the π^+-π^0 electromagnetic mass splitting and for the Landau-gauge gluon propagator.

6729 **On the contribution of electromagnetic penguins to ϵ'.** Sharpe, S.R. (Stanford Linear Accelerator Center, CA, USA). *Physics Letters [Section] B;* **194**: No. 4, 551-556(20 Aug 1987). Contract AC03-76SF00515.

I discuss the importance of the electromagnetic penguin (EMP) contribution to ϵ'. I confirm the corrections to earlier calculations found by Buras and Gerard (BG). Incorporating these corrections, I calculate the Wilson coefficients of the EMP operators using the full anomalous dimension matrices, and also using the large-N (number of colors) approach of BG. I disagree with BG on the coefficient of the EMP operator dominant at large N: my result is of opposite sign and smaller in magnitude. This means that for large N the EMP contribution increases ϵ', but by less than 1%. I also find that this Wilson coefficient is poorly estimated in the large-N approach. I agree with the BG result for the coefficient of the EMP operator subdominant at large N. This coefficient is large, and is well estimated using the large-N anomalous dimension matrices. I emphasize that the crucial factor determining the EMP contribution to ϵ' is the size of the hadronic matrix elements of the subdominant EMP operator. Though suppressed at large N, it increases ϵ' by 5-20% if one assumes vacuum insertion approximation, and by up to 100% if one uses the results from a recent lattice calculation.

6730 **Theoretical expectations for tau $\rightarrow$ eta$\pi\nu$.** Zachos, C.K.; Meurice, Y. (High Energy Physics Div., Argonne National Lab., Argonne, IL 60439). *Modern Physics Letters A;* **2**: No. 4, 247-250(Apr 1987). Contract W-31-109-ENG-38.

Known theoretical estimates are collected to stress that the reported second-class decay of the tau lepton at a 5% level is not explainable in conventional terms.

6731 **e/sup +/ -e/sup -/ hadronic multiplicity distributions.** Carruthers, P.; Shih, C.C. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). *Modern Physics Letters A;* **2**: No. 2, 89-108(Feb 1987).

The authors have analyzed the 29 GeV multiplicity data for e/sup +/ -e/sup -/ $\rightarrow$ hadrons using the partially coherent laser distribution (PCLD). The latter interpolates between the negative binomial and Poisson distributions as the ratio S/N of coherent/incoherent multiplicity varies from zero to infinity. The negative binomial gives an excellent fit for rather large values of the cell parameter κ. Equally good fits (for full and partial rapidity range, and for the forward/backward 2 jet correlation) are obtained for the mostly coherent (almost Poissonian) PCLD with small values of κ (equal to the number of jets). The reasons for the existence of this tradeoff are explained in detail. The existence of the resulting ambiguity is traced to the insensitivity of the probability distribution to phase information in the hadronic density matrix. They recommend the study of higher order correlations (intensity interferometry) among like-sign particles to resolve this question.

6732 **Why should baryons and exotic relic particles have comparable densities.** Turner, M.S.; Carr, B.J. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Lab., Batavia, IL 60510). *Modern Physics Letters A;* **2**: No. 1, 1-8(Jan 1987).

Observations suggest that the mass density of the Universe is dominated, not by ordinary matter, but by exotic particles which are a relic of the Big Bang. In this case, a new dimensionless cosmological ratio arises, the ratio of the mass density in ordinary matter to that in exotic matter, whose value is about 0.1. A priori,

it might seem remarkable that this ratio should be so close to unity. However, the authors point out that, for many exotic dark matter candidates, the ratio is related to the fundamental scales of particle physics. A value of order unity arises naturally provided rather simple relationships exist between these scales. If the exotic particles are of a kind whose relic abundance is determined by annihilations (e.g., the photino or a heavy neutrino), then the required relationship is already satisfied for independent, cosmological reasons.

6733 **Partial wave analysis of pp→NNπ and dibaryon resonances.** Wicklund, A.B. (Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 609-617(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

This talk summarizes results of a partial-wave analysis (PWA) of pup-arrowp→Δ^{++} n→pπ^+ n in the dibaryon resonance region, using comprehensive data on single spin correlations from the effective mass spectrometer at the Argonne Zero Gradient Synchrotron.[1] These results are compared with recent PWA for the bound nucleon final state, pp→π^+ d, by Bugg.[2] These reactions are closely related, and neither displays Breit-Wigner resonance behavior in the larger waves.

6734 **Grand unification, proton decay, and magnetic monopoles.** Goldhaber, M.; Marciano, W.J. (Brookhaven National Lab., Upton, NY, USA). *Comments on Nuclear and Particle Physics;* **16**: No. 1, 23-49(May 1986). Contract AC02-76CH00016.

The paper surveys the predictions of the grand unified theory (GUT), and compares them with experiment. The basic features of the SU(5) model are outlined, and its associations with $\sin^2$Qw and msub(x) (the unification mass) are examined. General aspects of proton decay are discussed, including: the decay rate predicted by the minimal SU(5), Higgs scalar mediated proton decay and effects due to supersymmetry. The expected properties of GUT magnetic monopoles are reviewed, and the consequences of strong proton decay catalysis are examined. (U.K.).

6735 **Symmetry of wavefunctions for 'like' unstable particles.** Goldhaber, M.; Weneser, J. (Brookhaven National Lab., Upton, NY, USA). pp 107-111 of From SU(3) to gravity. Festschrift in honor of Yuval Ne'eman. Gotsman, E.; Tauber, G. (eds.). Cambridge, England; Cambridge University Press (1985). Contract AC02-76CH00016.

Identity of two particles is usually demonstrated by showing that their wavefunction is either purely symmetric or purely antisymmetric. In analyzing experiments, "like" particles of finite lifetime, i.e., particles with a finite mass width, (e.g. muons or pions), are usually treated as "identical", though they have finite mass spreads. Since the corresponding wave functions consist of a spread of components that might differ because of differences in production mechanisms, one may ask: can the usual analysis be trusted for this case. Simple arguments suffice to show that it can be.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 6682, 6735, 6758, 6759, 6760, 6761

6736 **(JINR—R-2-86-598) Structure of helicity amplitudes and dispersion relations for massless gravitino-pion scattering.** Chavlejshvili, M.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700507/JAW.

The kinematic structure of the helicity scattering amplitudes of a massless fermion with spin 3/2 (gravitino) on a massive particle with zero spin (pion) is analysed. The kinematic structure is defined by the conservation laws and crossing-relations. The so-called dynamic amplitudes are introduced, which posses singularities defined by the unitarity conditions only. The dispersion relations for the helicity amplitudes are found on the basis of the parametrization suggested. 59 refs.

6454 Field Theory

REFER ALSO TO CITATION(S) 6727, 6728

6737 **(DOE/ER/40325—01) A Polyakov path integral with ghosts.** Ordonez, C.R.; Rubin, M.A.; Zucchini, R. (Rockefeller Univ., New York (USA); New York Univ., NY (USA). Dept. of Physics). 1987. Contract AC02-87ER40325. 12p. (RU—87/B1/13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002343/JAW.

We present a method for explicit evaluation of the Polyakov path integral with ghosts. The free propagator for the bosonic string, both with and without ghosts, is computed. 12 refs.

6738 **(IFT-P—20/87) Fermionization of strings, and their conformal invariant solutions.** Abdalla, E.; Abdalla, M.C.B. (Sao Paulo Univ., Brazil. Inst. de Fisica). (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700621/JAW.

The fermionic description of bosonic string theory, which turns out to be a Thirring model, is given. The relation of continuous spin to compactification is discussed, and regular solutions with finitely many fields can be found if the spin is a rational number. The relation between W.Z.W. theory and SU (n) Thirring model is also treated.

6739 **(IFUSP-P—594) Topological defects at finite temperature.** Bazeia Filho, D.; Eboli, O.J.P.; Guerra Junior, J.M.; Marques, G.C. (Paraiba Univ., Joao Pessoa, Brazil. Dept. de Fisica; UNESP, Rio Claro, Brazil. Inst. de Fisica). (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jul 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700625/JAW.

A scheme for computing the free energy of topological defects at finite temperature is developed. As an application, the free energy of topological defects (monopoles and domain walls) for the minimal SU(5) model is computed, by using the semiclassical approach at high temperatures. This procedure allows us to get a better picture of the phase diagram of gauge theories at finite temperatures and obtain the critical temperatures associated to the various phase transitions.

6740 **(ITEP—138(1986)) Resolution of singularities in superstring compactification. Toric method.** Markushevich, D.G.; Olshanetskij, M.A.; Perelomov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700775/JAW.

The toric method is exposed to resolve singularities arising in the superstring compactification constructed by dividing a torus by a discrete symmetry group. 2 refs.; 5 figs.

6741 **(JINR—R-2-86-645) Operator foundation of functional integral in non-Abelian gauge theory.** Nguen Suan Khan; Pervushin, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700508/JAW.

Submitted to the Intern. J. Modern Phys. A.

A part integral is constructed which corresponds to a relativistically covariant schemes of canonical quantization of a non-Abelian theory. A special attention is paid to the problem of ordering of operators in the Hamiltonian and of the integral independence of the choice of gauge of integration variables. It is shown that the Weyl ordering of strengths corresponds to the relativistic covariance. Transition to the axial gauge and associated problems are considered. 27 refs.

6742 **(JINR—R-2-86-685) Nonsymmetric metrics in nonlinear field theory.** Shavokhina, N.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700509/JAW.

Submitted to the collection Problemy teorii gravitatsii, relyativistskoj kinetiki i ehvolyutsii Vselennoj.

Algebraic and differential properties are considered of a nonsymmetric metrics introduced into field theory by Einstein and subsequently by Born and Infeld. It is shown that the nonsymmetric metrics is characterized by a pair of vector and a pair of covector fields connected by two identities. If these fields are zero, the nonsymmetric metrics is called harmonic one, an example is any metrics obeying the Born-Infeld equations. The theory of harmonic metrics may be considered as a direct generalization of the Born-Infeld theory. 2 refs.

6743 **(JINR—R-2-86-835) On supersymmetry transformations in the field theory with fundamental mass.** Ibadov, R.M.; Kadyshevskij, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700515/JAW.

Submitted to the journal DAN UzSSR.

It is shown that the contribution of the auxiliary fields to the Lagrangians of the field theory with fundamental mass is such that the sum of the kinetic terms corresponding to scalar and Majorana fields is invariant under supersymmetry transformations inherent in the Wess-Zumino model. 6 refs.

6744 **(JINR—R-5-86-628) Multisoliton solutions in the scheme of Unified description of integrable relativistic massive fields. Non-degenerate sl(2,C) case.** Barashenkov, I.V.; Getmanov, B.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 34p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700527/JAW.

Submitted to the journal Comm. Math. Phys. .

A scheme for systematic construction of integrable two-dimensional models of the Lorentz-invariant Lagrangian massive field theory is presented in the case when the associated linear problem is formulated on sl(2,C) algebra. A natural dressing procedure is developed then for the generic system of two (either scalar or spinor) fields inherent in the scheme and explicit N-soliton solution on zero background is calculated. Solutions of reduced systems which include both familiar and new equations are extracted from the solution of the generic system, only part of these reductions being immediately to sl(2,C) real forms. Finally, in the case of scalar equations the Miura-type transformations are presented relating solutions with different boundary conditions. 26 refs.

6745 **(JINR-E—2-86-635) Supersymmetric two-particle equations.** Sissakyan, A.N.; Skachkov, N.B.; Shevchenko, O.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700706/JAW.

Submitted to the journal Zeit. Phys. .

In the framework of the scalar superfield model, a particular case of which is the well-known Wess-Zumino model, the supersymmetric Schwinger equations are found. On their basis with the use of the second Legendre transformation the two-particle supersymmetric Edwards and Bethe-Salpeter equations are derived. A connection of the kernels and inhomogeneous terms of these equations with generating functional of the second Legendre transformation is found. 6 refs.

6746 **(KFKI—1987-40/A) Lattice classification of the four-dimensional heterotic strings.** Balog, J.; Forgacs, P.; Vecsernyes, P.; Horvath, Z. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Roland Eoetvoes Univ., Budapest, Hungary. Inst. for Theoretical Physics). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700734/JAW.

A lattice slicing procedure is proposed which leads to the classification of all four-dimensional chiral heterotic strings based on Conway and Sloane's 22-dimensional self-dual Euclidean lattices. By reversing this procedure it is possible to construct all these theories. 9 refs.

6747 **(LAPP-TH—188-87) Non-compact symmetries and scalar masses in superstring-inspired models.** Binetruy, P.; Gaillard, M.K. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). May 1987. 12p. (LBL—23424; UCB-PTH—87-14). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750634/JAW.

We show that one-loop corrections in the presence of broken supersymmetry do not generate gauge non singlet scalar masses in no-scale supergravity models that possess a partial invariance under a non-compact Heisenberg group of global transformations. This invariance is a remnant of an invariance of ten-dimensional supergravity that survives in some compactification schemes. We discuss the conditions under which compactification of a ten-dimensional superstring theory yields a Heisenberg symmetry.

6748 **(NBI-HE—87-45) Strings, fields and critical phenomena.** Ambjoern, J. (Niels Bohr Inst., Copenhagen (Denmark)). Jul 1987. 72p. (In English). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751035/JAW.

The connection between field theory and critical phenomena is reviewed. Emphasis is put on the use of Monte Carlo methods in the study of non-perturbative aspects of field theory. String theory is then described as a statistical theory of random surfaces and the critical behaviour is analyzed both by analytical and numerical methods.

6749 **(NBI-HE—87-50) Dynamical properties of superconducting cosmic strings. Pt. 2. Heavy closed strings in magnetic fields.** Nielsen, N.K.; Olesen, P. (Odense Univ., Denmark. Physics Inst.). (Niels Bohr Inst., Copenhagen (Denmark)). Aug 1987. 19p. (In English). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751038/JAW.

We discuss a circular static superconducting cosmic string in a homogeneous magnetic field and show that the mass is independent of the radius provided we choose a GUT scale as well as a reasonable value for the intergalactic magnetic field. A conservative estimate gives a mass of order 10/sup 16/ M/sub sun/. We also discuss various gravitational effects related to this string. The most striking effect is the gravitational lens effect that can produce four images.

6750 **(NBI-HE—87-52) Monte Carlo study of the Yang-Mills string wavefunctional in three dimensions.** Greensite, J. (San Francisco State Univ., CA, USA. Dept. of Physics and Astronomy). (Niels Bohr Inst., Copenhagen (Denmark); San Francisco State Univ., CA (USA). Dept. of Physics and Astronomy). Aug 1987. 12p. (In English). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751039/JAW.

The wavefunctional PSIsub(anti q)/sub q/[A], representing the ground state of a pure gauge theory containing fixed external quark-antiquark charges, has an exact path-integral representation. A simulation of this path-integral is carried out by the lattice Monte Carlo method, in Coloumb gauge, for an SU(2) gauge theory in D=3 dimensions. The existence of nodes in the wavefunctional, i.e. regions of field space where PSI=0, is used to indicate the presence of constituent gluons. The numerical data obtained suggests the existence of at least one constituent gluon in the confining string, for qanti q separations of R≅6 lattice spacings at a coupling β=5.5.

6751 **(OUP—87-21) Random walks of a quantum particle on a circle.** Fjeldsoe, N.; Midtdal, J.; Ravndal, F. (Oslo Univ. (Norway). Fysisk Inst.). Jul 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750352/JAW.

When the quantum planar rotor is put on a lattice, its dynamics can be approximated by random walks on a circle. This allows for fast and accurate Monto Carlo simulations to determine

the topological charge of different configurations of the system and thereby the Θ-dependency of the lowest energy levels.

6752 **(OUP—87-22) Fermionic Casmir effect at finite temperature.** Gundersen, S.A.; Ravndal, F. (Oslo Univ. (Norway). Fysisk Inst.). Aug 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750354/JAW.

Vacuum fluctuations of massless fermions between two parallel and confining plates give rise to an attractive Casimir force at zero temperature. It becomes repulsive at sufficiently high temperatures. All thermodynamic quantities are given by the free energy which satisfies a remarkable symmetry under temperature inversion. The fermion condensate varies between the plates and goes rapidly to zero with increasing temperature, except for a narrow region adjacent to the plates. 21 refs.

6753 **(SLAC-PUB—4429) String perturbation theory and effective Lagrangians.** Klebanov, I. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1987. Contract AC03-76SF00515. 8p. (CONF-8707129—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002568/JAW.

From Workshop on superstring; Boulder, CO, USA (27 Jul 1987).

We isolate logarithmic divergences from bosonic string amplitudes on a disc. These divergences are compared with 'tadpole' divergences in the effective field theory with a cosmological term, which also contains an effective potential for the dilation. Also, corrections to β-functions are compared with variations of the effective action. In both cases we find an inconsistency between the two. This is a serious problem which could undermine our ability to remove divergences from the bosonic string.

6754 **(UFPB-DF—09/86) Scalar eletrodynamics in three dimensions with topological mass terms.** Mello, E.R.B. de. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700748/JAW.

The interaction between a charged scalar field and a gauge field in a three-dimensional space-time is studied. The topological mass term (the Chern-Simons term) is added to the system and it is investigated how this term, odd by P and TAU symmetry, modifies the corrections to the propagators and vertices of this theory. These corrections are obtained to order e/sup 2/ in perturbation theory. In the correction of the linear vertex a new type term arises. Although this term, which comes from the topological one, presents and abnormal parity, the Ward's identity is still valid.

6755 **(UFPB-DF—10/86) Fermions and non-Abelian vortex.** Mello, E.R.B. de. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700749/JAW.

Some aspectos of the fermion-non-Abelian vortex system are discussed. It is shown that this system presents properties analogous to the fermion-non-Abelian magnetic monopole one. But, differrently from the fermion-monopole case, this system does not present fermion condensate < psi-bar psi >/sub V/ = 0.

6756 **Comment on real-time finite-temperature gauge field propagators.** Kowalski, L. (Argonne National Lab., IL, USA. High Energy Physics Div.). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **36**: No. 4, 665-667(Nov 1987). Contract W-31-109-ENG-38.

The gauge-fixing terms of the free, real-time thermal gauge field propagators corresponding to quantization in a covariant gauge obtained by Kobes, Semenoff, and Weiss are shown to be incorrect, apart from well-known signature ambiguities in the off-diagonal elements, and to differ from those obtained by Landsman using the method of the Klein-Gordon divisor. We obtain the correct forms which are then shown to coincide with Landsman's results by means of a distributional identity.

6757 **Contact interactions in closed superstring field theory.** Greensite, J.; Klinkhamer, F.R. (San Francisco State Univ., CA, USA. Dept. of Physics and Astronomy; Lawrence Berkeley Lab., CA, USA. Nuclear Science Div.). *Nuclear Physics [Section] B;* **291**: No. 3, 557-582(7 Sep 1987). Contract AC03-81ER40009;AC03-76SF00098.

We show that closed (type II and heterotic) superstring field theories, which are presently formulated without contact interactions in the light-cone gauge, do not have a stable vacuum state. States with arbitrary negative energy can be constructed in these theories; an explicit example is given. Negative energy states imply violation of the supersymmetry relation {Q/sup -A/, Q/sup -/sup(anti B)} = 2δ/sup A/sup(anti B)H. Using coherent state methods, we show that the super-Poincare algebra is indeed violated by the standard light-cone gauge superstring hamiltonians, since the supercharge anticommutator generates local, 4-string contact interactions at O(λ/sup 2/), where λ is the coupling of the 3-vertex. Contact interactions must therefore be added to the usual hamiltonian to restore supersymmetry and vacuum stability.

6758 **Large cross-sections for W/sup +/W/sup -/ and Z/sup 0/Z/sup 0/ pairs and color sextet quarks.** White, A.R. (High Energy Physics Div., Argonne National Lab., Argonne, IL 60439). *Modern Physics Letters A;* **2**: No. 6, 397-408(Jun 1987). Contract W-31-109-ENG-38.

Dynamical electroweak symmetry breaking by a chiral condensate of color sextet quarks is expected to produce large cross-sections for W/sup +/W/sup -/ and Z/sup 0/Z/sup 0/ pairs due to direct QCD production. Cross-section estimates based on a combination of chiral and diffractive scaling arguments are shown to be consistent with the candidate events observed at CERN. Other implications of sextet quarks for QCD dynamics and for Grand Unification are also briefly described.

6759 **Electroweak anomaly and lepton asymmetry.** Kolb, E.W.; Turner, M.S. (Theoretical Astrophysics Group, Fermi National Accelerator Lab., Batavia, IL 60510). *Modern Physics Letters A;* **2**: No. 5, 285-292(May 1987).

It has previously been pointed out that shortly after the electroweak phase transition (t ≃ 10/sup 11/ sec, T ≃ 100-200 GeV) there was a period of very effective baryon (and lepton) number violation driven by non-perturbative effects arising from the electroweak anomaly. The authors argue that as a result of these electroweak interactions the total asymmetry in leptons must be equal and opposite to the baryon asymmetry: L identical to Σ/sub i/L/sub i/ = L/sub e/ + L/sub μ/ +L/sub τ/ = -B. Since the individual lepton numbers can be positive or negative, this does not preclude any large individual contribution, i.e, absolute value of L/sub i/ > B. This fact has important consequences for primordial nucleosynthesis if absolute value of L/sub i/ ≧ 1.

6760 **A unique SU(5) and SO(10) unification with complete dynamical symmetry breaking.** Kang, K.; White, A.R. (Physics Dept., Brown Univ., Providence, RI 02912). *International Journal of Modern Physics A;* **2**: No. 2, 409-442(Apr 1987).

A unique asymptotically free, anomaly-free, SU(5) gauge theory is proposed as a possible complete unification of the standard model in which all symmetry-breaking is dynamical. The asymptotic freedom constraint is saturated, removing renormalon divergences and leaving well-defined instanton interactions as the only nonperturbative ingredient of the theory. Consequently, it is argued, topological vacuum polarization of a very heavy, unconventional quantum number, quark sector dominates the dynamics, producing SU(5) symmetry breaking and a three generation low energy spectrum. Electroweak symmetry breaking is due to a chiral condensate of color sextet quarks. The embedding of the theory in single SO(10) representation is used for the dynamical analysis and may also have physical significance.

6761 **Inequivalence of the Brink-Schwarz and Siegel superparticles.** Allen, T.J. (California Institute of Technology, Pasadena, CA 91125). *Modern Physics Letters A;* **2**: No. 3, 209-214(Mar 1987).

Dirac's procedure is applied to the Brink-Schwarz and Siegel superparticle systems. Both systems are exhibited to have the same first-class constraints. The difference between the systems is the lack of second-class fermionic constraints in the Siegel superparticle. Thus the Siegel superparticle has a phase space with twice as many fermionic degrees of freedom as the Brink-Schwarz superparticle.

6762 **Zero point energy in parastring theories.** Mansouri, F.; Wu, X. (Physics Dept., Univ. of Cincinnati, Cincinnati, OH 45221). *Modern Physics Letters A;* **2**: No. 3, 215-220(Mar 1987).

The authors point out that the regularization of the zero point fluctuations in parastring theories provides an alternative method of obtaining the critical dimensions for these theories.

65 PHYSICS II

REFER ALSO TO CITATION(S) 6208

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 6655

6763 **(INIS-mf—10737) Max-Planck-Institute for Nuclear Physics. Annual report 1986.** Klapdor, H.V.; Jessberger, E.K. (eds.). (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)). 1987. 195p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750558/JAW.

This annual report contains short descriptions of the research performed at the given institute together with an extensive list of publications. The research in nuclear physics is concerned with developments in accelerators and ion sources, radiation detectors, solid-state studies by nuclear methods, counting circuits, data processing, target preparation, fission, fusion, and nuclear friction, giant resonances, nuclear spectroscopy, nuclear reaction mechanisms, atomic physics and interaction of charged particles with matter, medium and high energy physics. The research in cosmophysics works on meteorites and lunar rocks, the gallium-solar-neutrino experiment (project GALLEX), problems of Halley's comet, interplanetary and interstellar dust, planetary atmospheres, interstellar medium and cosmic rays, molecular collision processes in the gas phase, nuclear geology and geochemistry, and archaeometry.

6764 **(JINR—R-3-86-599) Differential elastic scattering cross sections of kiloelectronvolt neutrons on nuclei.** Popov, A.B.; Samosvat, G.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700519/JAW.

On the IBR-30 reactor the measurements of angular distributions of elastic scattering of neutrons have been performed on Cu, Y, Nb, In, Sb, Nd in the energy region up to 440 keV. The differential cross sections were described by the formula: $\sigma(\Theta)=\sigma$/sub S//$4\pi[1+\omega$/sub 1/P/sub 1/(Cos$\Theta)+\omega$/sub 2/P/sub 2/(Cos$\Theta)]$. The tables of values of total cross sections σ/sub S/ and anisotropy coefficients ω/sub 1/ and ω/sub 2/ are given. 5 refs.; 1 tab.

6765 **(JINR-R—1-86-664) Emission of the /sup 6/He and /sup 6,7,8/Li fragments in /sup 4/He interactions with silver and gold nuclei at 3.33 GeV/nucleon.** Avdejchikov, V.V.; Gorshkova, N.L.; Zhidkov, N.K. and others. (Radievyj Inst., Leningrad, USSR; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of High Energy). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700710/JAW.

Submitted to the journal Nucl. Phys. A.

Inclusive cross sections for the emission of /sup 6/He and /sup 6,7,8/Li at laboratory angles of 45 deg, 90 deg and 135 deg in /sup 4/He collisions with Ag and Au targets at a beam kinetic energy of 3.33 GeV/nucleon are presented. Assuming the existence of an intermediate object emitting secondary particles, its velocity and temperature for different fragment energies have been founded. The ratios of the spectra of /sup 6/He to /sup 6/Li and /sup 7/Li to /sup 6/Li are considered. It has been shown that the inclusive cross sections can be successfully described assuming the existence of two mechanisms of fragment emission: the evaporation of slow fragments from the residual nucleus and the decay of fireball-like objects. No qualitative difference has been found between the production processes of the lightest (A/sub f/=1-4) and medium-mass (A/sub f/=6-8) fragments. 29 refs.; 8 figs.

6766 **Barrier penetration calculation of heavy-ion fusion cross sections in the above- and sub-barrier regions.** Haider, Q.; Malik, F.B. (Los Alamos National Lab., NM, USA; Southern Illinois Univ., Carbondale, US. Dept. of Physics and Astronomy). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 6, 537-546(Jun 1986). Contract W-7405-ENG-36.

Results of a barrier penetration calculation of heavy-ion fusion cross sections for the systems ^{12}C and ^{9}Be, ^{11}B, ^{12}C, ^{13}C, ^{14}N, ^{15}N, ^{16}O, ^{17}O, ^{18}O, ^{19}F, ^{20}Ne and ^{24}Mg, ^{18}O and ^{24}Mg, ^{19}F and ^{27}Al, ^{28}Si and ^{30}Si, and ^{16}O and ^{40}Ca are presented here. The model employed takes into account the Coulomb interaction barrier and is valid at energies both above and below the Coulomb barrier. The model can fit the data in both the above- and sub-barrier regions. The calculated results, including the maximum fusion cross section and the energy at which the maximum occurs, are found to be consistent with the experimental data.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 6725

6767 **(DOE/ER/40281—T1) [Relativistic heavy ion physics program: Technical progress report].** (Columbia Univ., New York (USA)). 1987. Contract FG02-86ER40281. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002368/JAW.

The main activity reported is participation in Experiment E802 at the Brookhaven AGS. Activities discussed include design and construction of segmented Cherenkov counters, streamer-tube back counters, and the Cherenkov complex, as well as data analysis work. (LEW)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

6768 (N—87-28430, pp 9) **4He(p,d)3He reaction at 200 and 400 MeV.** Alons, P.W.F.; Kraushaar, J.J.; Shepard, J.R.; Cameron, J.M.; Hutcheon, D.A.; Liljesttand, R.P.; Mcdonald, W.J.; Miller, C.A.; Olsen, W.C.; Tinsley, J.R. (Oregon Univ., Eugene). Dec 1985. NTIS, PC A04/MF A01. (NASA-CR—181255; NAS—1.26:181255).

In Activities of the Solid State Physics Research Institute. Annual report, 1 January-31 December 1985.

The distorted wave calculations are compared with the He-4(p,d) cross section. At all four energies the theoretical description of the data is relatively poor. While the general magnitude of the cross sections is not in bad agreement, the detailed slopes of the theoretical angular distributions miss the shapes of the experimental data in a rather fundamental way.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

6769 **(JINR-R—1-86-639) Temperature and density of nuclear matter in CC interactions at P=4.2 Gev/c per nucleon.** Grishin, V.G.; Didenko, L.A.; Kuznetsov, A.A.; Miller, K.; Plyuta, Ya.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of High Energy; Tbilisskij Gosudarstvennyj Univ., USSR). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700709/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

An estimation of the temperature and density of nuclear matter in all CC inelastic and CC multi-nucleon interactions at P/A=4.2 GeV/c is presented. In this analysis the proton data on determination of these characteristics are used. In multi-nucleon CC collisions the average value of temperature and density are equal to: T/sub 0/ ≅ 180 MeV, rho/rho/sup norm./=3.6/sub -2.2//sup +1.8/. 24 refs.; 5 figs.; 4 tabs.

6770 **High-resolution inelastic electron scattering from /sup 17/O.** Manley, D.M.; Berman, B.L.; Bertozzi, W.; Buti, T.N.; Finn, J.M.; Hersman, F.W.; Hyde-Wright, C.E.; Hynes, M.V.; Kelly, J.J.; Kovash, M.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1700-1726(Nov 1987). Contract W-7405-ENG-48.

Excited states of /sup 17/O up to an excitation energy of 15 MeV have been studied by high-resolution electron scattering for momentum transfers between 0.8 and 2.6 fm/sup -1/. Previous electron-scattering measurements in this excitation region were confined to momentum transfers below 1.1 fm/sup -1/ and were of lower resolution. Form factors were measured and reduced transition probabilities determined for most excited states below 9.5 MeV. The present data are interpreted within the framework of weak-coupling models to facilitate a simple description of the observed spectrum. Particular emphasis is placed upon understanding states that are excited strongly by electric quadrupole or octupole transitions. Spins and parities have been assigned for several levels that have very narrow widths and, hence, are not amenable to partial-wave analyses involving the /sup 16/O+n and /sup 13/C+α reactions. Levels at 5.87 MeV ($(3/2^+)$), 6.86 MeV ($(5/2^+)$), 7.58 MeV ($(7/2^+)$), and 8.47 MeV ($(9/2^+)$) are suggested as candidates for predominantly 5p-4h members of a K/sup π/ = $(3/2^+$ rotational band. A narrow state ($\Gamma \leq 20$ keV) at 12.22 +- 0.02 MeV was observed for the first time and the existence of narrow states at 8.90 +- 0.02 and 14.72 +- 0.02 MeV was confirmed.

6771 **Measured activation cross-section ratios for ^{7}Li(n,n't)^{4}He and ^{60}Ni(n,p)^{60}Co relative to ^{27}Al(n,p)^{27}Mg and ^{27}Al(n,α)^{24}Na in the ^{9}Be(d,n)^{10}B thick-target neutron spectrum at 7-MeV deuteron energy.** Smith, D.L.; Meadows, J.W.; Bretscher, M.M. (Argonne National Lab., IL, USA). *Annals of Nuclear Energy;* **13**: No. 5, 233-235(1986).

The activation method is used to measure integral cross-section ratios for ^{7}Li(n,n't)^{4}He and ^{60}Ni(n,p)^{60}Co relative to ^{27}Al(n,p)^{27}Mg and ^{27}Al(n,α)^{24}Na in the neutron spectrum produced by bombarding a thick Be metal target with 7-MeV deuterons. The results of these measurements are found to support the evaluated differential cross-section values from ENDF/B-V (1979, 1981).

6514 Nuclear Properties And Reactions, A=20-38, Experimental

6772 **(IPNO-DRE—87-18) Beta-delayed proton decay of the T/sub z/=-5/2 Isotope /sup 31/ Ar.** Anne, R.; Bazin, D.; Delagrange, H. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750633/JAW.

Beta-delayed proton radioactivity has been observed for the T/sub z/=-5/2 isotope sup 31 Ar which has been produced by projectile fragmentation of sup 36 Ar at 85 MeV/u. The proton energy spectra recorded by the LISE spectrometer during this experiment show evidence for beta-delayed proton and possibly beta-delayed two-proton decay of this nucleus. Direct two-proton decay is rather unprobable since the measured sup 31 Ar half-life of 15 +- 3 ms is in good agreement with the calculated beta-delayed half-life (13.4 ms). As a conclusion, the experimental method described in this paper is very powerful for the study of beta-delayed emission of charged particles (p, 2p and alpha particles) in the decay of neutron-deficient nuclei.

6773 **(JINR—R-1-86-828) Fragmentation of relativistic neon-22 nuclei on photoemulsion nuclei.** Andreeva, N.P.; Anzon, Z.V.; Bubnov, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700505/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Multiplicities, distributions in transverse momenta and their parameters for inelastic interactions of neon-22 nuclei with emulsion nuclei at 4.1 GeV/c are presented. The violation of the factorization principle for fragmentation cross sections is shown. The yield of light fragments with large transverse momenta is observed in these interactions. The dependence of this yield on different interaction characteristics has been investigated. 15 refs.; 6 figs.; 5 tabs.

6774 **(JINR-R—7-86-727) Measurement of decay duration of the excited reaction product of the Ne+Ge inelastic nuclear interaction.** Karamyan, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700721/JAW.

Submitted to the journal Yad. Fiz. .

Monocrystal Ge targets are irradiated with /sup 20/Ne and /sup 22/Ne ions at the 4 to 8 MeV/nucleon energy (E/sub L/) interval in order to estimate the time duration of inelastic interaction nuclear reaction with using shadow effect. Track detector methods are applied to particle registration and discrimination of the target like products from scattered ions. A relatively intensive blocking effect is observed at the investigated detection angle (Θ/sub L/ =35-75 deg) for the heavy inelastic products. Blocking minimum yield γ is increasing noticeably at the transition from kinematical region of quasielastic reaction to the deep inelastic one. The measured dependences γ(Θ/sub L/, E/sub L/) satisfy without any contradictions the interpretation based on the effect of the excited product decay duration. A new possibility is discussed of experimental verification of the decay duration independence from population way for nuclear state excited in different reactions. 18 refs.; 4 figs.

6775 **(N—87-28430, pp 32) 200 MeV Pi+ induced single-nucleon removal from 24Mg.** Joyce, D.; Funsten, H.O.; Lieb, B.J.; Plendl, H.S.; Norton, J.; Stronach, C.E.; Lind, V.G.; Mcadams, R.E.; Otteson, O.H.; Vieira, D.J. (Los Alamos National Lab., NM). Dec 1985. NTIS, PC A04/MF A01. (NASA-CR—181255; NAS—1.26:181255).

In Activities of the Solid State Physics Research Institute. Annual report, 1 January-31 December 1985.

Nuclear gamma-rays in coincidence with outgoing pions or protons following single nucleon removal from Mg-24 by 200 MeV pions (+) were detected with Ge(Li) detectors. Differential cross sections are reported for gamma-rays from the first excited mirror states of Na-23 and Mg-23 in coincidence with positive pions or protons detected in particle telescopes at 30, 60, 90, 120, and 150 deg; angle-integrated absolute cross sections and cross section ratios are calculated. These results are compared with the predictions of a Pauli-blocked plane-wave impulse approximation (PWIA) and the intranuclear cascade (INC) and nucleon charge exchange (NCX) reaction models. The PWIA and the INC calculations generally agree with the angular dependence of the experimental results but not the absolute magnitude. The NCX calculation does not reproduce the observed cross section charge ratios.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

6776 **Reactions with /sup 40/Ar and /sup 84/Kr leading to the same compound nucleus, /sup 200/Po.** Hahn, R.L.; Toth, K.S.; LeBeyec, Y.; Lagarde, B.; Guidry, M.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2132-2135(Nov 1987). Contract AC05-84OR21400.

Excitation functions were measured for the deexcitation by neutron evaporation of the compound nucleus /sup 200/Po formed in the interactions of /sup 84/Kr+/sup 116/Cd and /sup 40/Ar+/sup 160/Dy. In general, the results are consistent with the predic-

tions of the statistical model of nuclear reactions, including effects of angular momentum and deexcitation by fission. However, few neutron (2n,3n) evaporation is more favored in /sup 84/Kr-induced reactions than in those involving /sup 40/Ar, a result that is not predicted by the statistical model.

6777 **New limits on the double beta decay half-lives of /sup 94/Zr, /sup 96/Zr, /sup 116/Cd and /sup 124/Sn.** Norman, E.B.; Meekhof, D.M. (Lawrence Berkeley Lab., CA, USA). *Physics Letters [Section] B;* **195**: No. 2, 126-129(3 Sep 1987). Contract AC03-76SF00098.

Searches have been made for the double beta decays of /sup 94,96/Zr, /sup 116/Cd, and /sup 124/Sn to excited states in their daughter nuclei. No evidence of any of these decays was found, and lower limits on the half-lives against such decays have been established to be 10/sup 18/-10/sup 19/ yr. In addition, the single beta decay half-life of /sup 96/Zr has been established to be ≧ 1.7 x 10/sup 18/ yr.

6778 **Studies of nuclear structure in antinucleon charge-exchange reactions.** Auerbach, N. (Los Alamos National Laboratory, Los Alamos, NM 87545; School of Physics and Astronomy, Tel-Aviv University, Tel-Aviv, Israel). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 520-525(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The antinucleon-nucleus charge exchange reaction is discussed and its use as a probe of isovector excitations in nuclei is described. Attention is drawn to the fact that the (p-bar, n-bar) reaction will predominantly excite "pionic" (i.e., longitudinal spin) modes in nuclei. Comparison between (p-bar,n-bar) and (n,p) reactions is made. Plans for (p-bar,n-bar) experiments in the near future are mentioned.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

6779 **(JINR—R-3-86-587) Study on the radiative strength function of /sup 174/Yb nucleus by means of the (n,γ) reaction in isolated resonances.** Bechvarzh, F.; Gonzatko, Ya.; Montero-Kabrera, M.Eh.; Telezhnikov, S.A.; Khoang Tyong Khiep. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700517/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Spectra of γ-rays following the neutron capture by /sup 173/Yb at isolated resonances were measured by means of the time-of-flight method. Absolute intensities of some transitions have been obtained. Combining the results of this work and published data photon strength function (PSF) of /sup 174/Yb has been determined. The obtained values of this function are compared with those expected by Lorentzian extrapolation of the giant dipole resonanCe. Mean values of PSF for samples of correlated and non-correlated transitions from different resonances indicate a possible violation of random fragmentation of giant resonance. Independence of PSF on resonance spin is confirmed for /sup 174/Yb. 19 refs.; 2 figs.; 2 tabs.

6780 **(JINR-R—6-86-850) Decay of /sup 174/Lu possibility of electron neutrino mass estimation.** Vasil'ev, S.K.; Batsev, S.; Brianson, Sh. and others. (Radievyj Inst., Leningrad, USSR; Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika; TsYaSMS, Orsey, France). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700720/JAW.

Submitted to the 37. Conference on nuclear spectroscopy and nuclear structure, Yurmala, Apr 1987.

The energies and population probabilities of /sup 174/Yb excited levels were revised in γ-ray measurements of /sup 174/Lu decay. The attempt to discover K-capture low energy branch in decay of /sup 174/Lu at the 1318 keV level of /sup 174/Yb was made. Existence of such branch would give the opportunity for estimation of electron neutrino mass. With this aim KX-ray measurements in coincidence with 1318 keV γ-ray have been carried out. Relative probability of this process was estimated to be ≦ 1.1x10/sup -3/. 18 refs.; 7 figs.

6781 **(LAFI—096) Nuclear levels of /sup 163/Dy.** Kuvaga, I.L.; Bondarenko, V.A.; Kramer, N.D.; Nejburg, L.A.; Upitis, I.V.; Prokofjev, P.T. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700739/JAW.

Gamma-radiation spectra have been measured in the energy range of 93-850 keV for the /sup 163/Dy (n, n'γ) reaction, and a comparison with the gamma-radiation spectrum of the (n, γ) reaction has been done. The data analysis allows to extend the /sup 163/Dy level scheme up to 1.2 MeV of the excitation energy. The level determination is based on energy balance for populating and depopulating gamma transitions. The level spin values have been estimated by a comparison of the transition intensities for the (n, n'γ) and (n, γ) reactions. Some new levels have been introduced basing on measured gamma-gamma coincidences. 13 refs.; 3 figs.; 2 tabs.

6782 **(OUP—87-25) First-generation γ-rays from highly excited, even rare-earth nuclei.** Zelazny, Z.; Tveter, T.S.; Atac, A.; Guttormsen, M.; Ramsoey, T.; Rekstad, J. (Oslo Univ. (Norway). Fysisk Inst.). Aug 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750355/JAW.

A low energy bump (E/sub γ/—0.4 MeV) has been observed in the first-generation γ-ray spectra from highly excited, even rare-earth nuclei populated in the (/sup 3/He,α) reaction. The particle-gamma angular correlations indicate dipole or unstretched quadrupole character. This bump cannot be explained within the frames of the Fermi gas model.

6783 **Particle-hole states at high spin in /sup 150/Dy.** Deleplanque, M.A.; Bacelar, J.C.; Beck, E.M.; Diamond, R.M.; Stephens, F.S.; Draper, J.E.; Doessing, T.; Neergard, K. (Lawrence Berkeley Lab., CA, USA. Nuclear Science Div.; California Univ., Berkeley, USA). *Physics Letters [Section] B;* **195**: No. 1, 17-21(27 Aug 1987). Contract AC03-76SF00098.

The level scheme of the nucleus /sup 150/Dy up to spin around 40 was obtained using the reaction /sup 114/Cd(/sup 40/Ar,4n). Above spins 20 to 22 - the highest obtainable from the valence nucleons - the breaking of the /sup 146/Gd proton and neutron cores occurs in separate parallel cascades.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

6784 (INIS-mf—11052, pp vp) **Nuclear shapes and configurations in the transiend region studied by anisotropic particle emission.** Wouters, J.; Vandeplassche, D.; van Walle, E.; Severijns, N.; Vanneste, L. (Louvain Univ., Belgium. Inst. for Nuclear- and Radiationphysics). 1985. NTIS (US Sales Only), PC A19/MF A01. Order Number DE88700667/JAW. (CONF-8509430—).

From International summer school on hyperfine interactions and international study meeting: physics with oriented nuclei; Bechyne, Czechoslovakia (2 Sep 1985).

A facility is described allowing to study the alpha decay of oriented radioactive nuclei. Practical experience is reported with the operation of alpha detectors at helium temperature. Preliminary experiments are described performed with the short-lived radionuclides /sup 199m/Po, /sup 199/At, /sup 201/At, and /sup 203/At. (Z.J.).

6785 **Transition multipolarities in ^{195}Pt.** Casten, R.F.; Colvin, G.G.; Schreckenbach, K. (Brookhaven National Lab., Upton, NY, USA; Koeln Univ., Germany, F.R. Inst. fuer Kernphysik; Institut Max von Laue - Paul Langevin, 38 - Grenoble, France). *Journal of Physics F (London). Metal Physics (London);* **13**: No. 2, 221-226(Feb 1987).

The $^{194}Pt(n, e^-)^{195}Pt$ reaction was studied to determine transition multipolarities and mixing ratios in ^{195}Pt in order to provide more sensitive tests of the predictions of multi-j U(6/12) supersymmetries in this nucleus. The E2 parts in transitions of most possible mixed multipolarities were found to be small and dominated by M1 components. Indeed, for all transitions that are forbidden by the E2 selection rules of the U(6/12) scheme, the data are consistent with pure M1 multipolarities. The limits on E2/M1 mixing ratios provide information useful for resolving ambiguities in delta values in recent Coulomb excitation experiments.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

6786 (CONF-8511312—1) Recent fission cross section standards measurements. Wasson, O.A. (National Bureau of Standards, Washington, DC (USA)). 1985. Contract AI01-86ER40275. 10p. NTIS, PC A02. Order Number DE88001714/JAW.

From 15. international symposium on nuclear physics - nuclear fission; Gaussig, German D.R. (11 Nov 1985).

The $^{235}U(n,f)$ reaction is the standard by which most neutron induced fission cross sections are determined. Most of these cross sections are derived from relatively easy ratio measurements to ^{235}U. However, the more difficult $^{235}U(n,f)$ cross section measurements require the use of advanced neutron detectors for the determination of the incident neutron fluence. Examples of recent standard cross section measurements are discussed, various neutron detectors are described, and the status of the $^{235}U(n,f)$ cross section standard is assessed. 23 refs., 8 figs., 4 tabs.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 6718, 6770

6787 (CONF-8708164—1) Probing the vacuum with highly charged ions. Bottcher, C.; Strayer, M.R. (Argonne National Lab., IL (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract W-31109-ENG-38;AC05-84OR21400. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001431/JAW.

From International conference on spectroscopy and structure of highly ionized atoms; Lisle, IL, USA (17 Aug 1987).

The physics of the Fermion vacuum is briefly described, and applied to pair production in heavy ion collisions. We consider in turn low energies (<50 MeV/nucleon), intermediate energies (<5 GeV/nucleon), and ultrahigh energies such as would be produced in a ring collider. At high energies, interesting questions of Lorentz and gauge invariance arise. Finally, some applications to the structure of high Z atoms are examined. 14 refs., 11 figs.

6788 (CSIR-TWISK-TR—440) Folding model of deuteron optical potential in momentum space. Greben, J.M. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). Jan 1986. 32p. CSIR, Publications Distribution, P.O. Box 395, Pretoria, 0001, South Africa.

The deuteron folding potential in momentum space is expressed in terms of deuteron form factors and nucleon-nucleus potentials in momentum space. The influence of each deuteron form factor on the potential and on the elastic scattering observables at intermediate energies is investigated. We find that the nucleon-nucleus spin-orbit potential plays a dominant role in most observables in this energy range. The deuteron D-state has little impact on A/sub y/, but is of growing importance for A/sub yy/, T/sub 20/ and T/sub 21/. The mixing between central and spin-orbit nucleon-nucleus contributions is considerable.

6789 (CSIR-TWISK-TR—448) Unitarity in elastic scattering of spin-half particles from spin-zero particles. Greben, J.M. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). Mar 1986. 10p. CSIR, Publication Distribution, P.O. Box 395, Pretoria, 0001, South Africa.

Unitarity relations for the non-spin-flip and spin-flip amplitudes in spin-half spin-zero elastic scattering are derived. One of these relations leads to the well-known optical theorem, which expresses the imaginary part of the forward non-spin-flip amplitude into elastic scattering observables plus an inelastic contribution in the inelastic region. We find that the corresponding relation for the imaginary part of the forward spin-flip amplitude cannot be expressed exclusively in elastic scattering observables plus an inelastic contribution, unless further approximations are made. We establish an optimal approximation for intermediate energies and discuss the possible usefulness of this relation.

6790 (CSIR-TWISK-TR—503) Contributions of two-gluon exchange diagrams to the NN spin-orbit interaction. Tzeng, Yiharn. (Academia Sinica, Republic of China). (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). Dec 1986. 25p. CSIR, Publications Distribution, P.O. Box 395, Pretoria, 0001, South Africa.

Contributions of the two-gluon exchange diagrams to the nucleon-nucleon spin-orbit interaction are investigated via the Glauber approximation, and comparisons are made with the gluon-quark exchange diagrams calculated in the resonating group method. Numerical results at E/sub lab/ = 800 MeV show that contributions from these diagrams are relatively small as compared to those from the resonating group calculations when the oscillator parameter λ of the 3-quark cluster and the interaction range a are fitted from the nucleon radius r/sub N/ at 0.83 and 0.59fm. A non-negligible contribution for λ and a at r/sub N/ = 0.42fm. Possible reasons are briefly discussed.

6791 (IFT-S—02/86) Semiclassical approximations in a mean-field theory with collision terms. Galetti, D. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1986. 24p. (In Portuguese). (CONF-8608195—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700623/JAW.

From 9. workshop on nuclear physics; Caxambu, Brazil (30 Aug 1986).

Semiclassical approximations in a mean-field theory with collision terms are discussed taking the time dependent Hartree-Fock method as framework in the obtainment of the relevant parameters.(L.C.).

6792 (IFUSP-P—596) Dispersion relation approach to sub-barrier heavy ion fusion reactions. Franzin, V.L.M.; Hussein, M.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jul 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700626/JAW.

With the aid of an inverse dispersion relation, which gives the imaginary part of the fusion inclusive polarization potential (IPP) in terms of the principal part integral involving the real part of the IPP, the sub-barrier fusion of heavy ions is discussed. The system /sup 16/O+/sub A/Sm is taken as an example. The reactive content of the extracted IPP is analysed within the coupled channels theory.

6793 (IFUSP-P—597) Correlations in the Sp (1,R) model for the monopole oscillations. Passos, E.J.V. de; Oliveira, M.M.B.M. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jul 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700627/JAW.

In the framework of the Sp(1,R) model for the monopole oscillations, it is examined how the ground state correlations affect the monopole operator sum rules m/sub l/, O≦l≦3, in /sup 16/O and /sup 40/Ca. The way of correlations indicates their importance for the even sum rules, whereas the odd ones practically are not affected by it. Since the scaling incompressibility is proportional to m/sub 3/, it is also concluded that thescaling incompressibility is not sensitive to ground state correlations. The above conclusions are in agreement with the RPA results.

6794 **(ITEF—12(1986)) Manifestation of a dynamics of the ternary fission with alpha particle emission in p-odd angular asymmetry of fragments.** Rzhevskij, E.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700673/JAW.

Suppression of p-odd angular asymmetry caused by higher and more close to the full degree of dissipation of fission motion can take place in the ternary fission with α-particle emission in comparison with the binary fission. Suppression is estimated by the ratio of p-wave parameters of neutron resonances <Γp>/D (where Γp and D is the level width and the distance between resonances). Dissipation binding and angular asymmetry of fragments points to a new direction in investigating the dynamics of nuclear fission. 6 refs.

6795 **(JINR—R-2-86-731) On mechanism of the nucleon pair correlation intensification in hadron-nucleus interactions.** Allaberdin, M.L.; Yuldashev, B.S.; Lednitski, R.; Lyuboshits, V.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700510/JAW.

Submitted to the journal Yad. Fiz. .

The pair correlations of protons produced with nearly equal velocities are calculated under various assumptions about space-time dimensions and form of the production region for the spherically-symmetrical and spherically-nonsymmetrical Gaussian distributions, for the uniform distributions in the sphere volume and sphere surface, in framework of the correlated tube model. Comparison of the experimental data with the theoretical predictions, taking into account the contribution of strong and electromagnetic final state interaction together with the effect of Fermi-statistics, indicates that the experimentally observed intensification of pair correlations of protons with increasing momenta can be related with the decreasing transverse dimensons of the fast proton production region. 20 refs.; 3 figs.

6796 **(JINR—R-2-86-741) Fast-rotating bodies.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700512/JAW.

The possibility of application the transformation formulas for energy and angular momentum of fast-rotating bodies to the description of nuclear rotating spectra is discussed. The formulas follow from Lorentz-Like (tangential) transformations for coordinates providing the form-invariance of interval and describing the relativistic rotation. 8 refs.

6797 **(JINR—R-4-86-625) Isovector polarization of nuclei in heavy ion collisions.** Dzholos, R.V.; Ivanova, S.P.; Korovin, P.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700522/JAW.

Submitted to the journal Yad. Fiz. .

The influence of the Coulomb repulsion on the distribution of protons and neutrons in nuclei in peripherial heavy ion collisions are analysed. The variation of isovector component of the nuclear density, the average number of giant dipole phonons excited, during the reaction and the renormaization of the nuclear interaction potential due to redistribution of nucleons are calculated for the /sup 208/Pb+/sup 208/Pb reaction at different kinetic energies. It is shown that the variation of isovector component of the nuclear density can be as high as 0.15 rho. 6 refs.; 3 figs.

6798 **(JINR—R-4-86-757) Neutron strength functions of odd spherical nuclei.** Voronov, V.V.; Zhuravlev, I.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700524/JAW.

The general expression for optical transmission of a nucleus taking into account the microscopic structure of the states is obtained on the basis of general terms of scattering theory and Feshbach's projection treatment. The process of nucleon absorption into compound states at the near-threshold energies is considered. The nuclear structure is treated on the basis of quasiparticle-phonon model of a nucleus. As an example the S and P strength functions of a few odd spherical nuclei are computed. 12 refs.

6799 **(JINR—R-4-86-784) Magnetic resonance in /sup 206/Pb.** Vdovin, A.I.; Ponomarev, V.Yu.; Velchev, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700525/JAW.

Submitted to the journal J. Phys. G: Nucl. Phys. .

The fragmentation of the magnetic dipole states in /sup 206/Pb nucleus is studied in the framework of the quasiparticle-phonon nuclear model. Qualitative presentation of M1-resonance fragmentation is close to experimental one. Total strength of M1-transitions agrees with the experimental one, the values of efficient gyromagnetic factors being by 20% less than their free values. Isoscalar 1/sup +/-state is shown to be present in /sup 206/Pb. Due to quasiparticle interaction with phonons its structure contains sizeable two-phonon components. Characteristics of the given level are similar to the experimental ones of latey detected in gamma-quanta resonance scattering 1/sup +/-level with 5.8 MeV energy in this nucleus. Direct transitions to two-phonon 1/sup +/-levels give a negligible contribution to the total excitation probability of the M1-resonance. 24 refs.; 4 figs.

6800 **(JINR—R-4-86-814) Exchange effects in elastic and inelastic scattering of alpha particles and heavy ions.** Dao Tien Kkhoa; Knyaz'kov, O.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700526/JAW.

Submitted to the journal Zeitschrift fur Physik.

A self-consistent semimicroscopic model to describe elastic and inelastic scattering of composite nuclear particles is applied to the analyses of data on α-particle and heavy ion scattering at the energies up to ~ 40 MeV/nucleon. With exchange parts of optical potential and form factors of inelastic transitions, calculated from the first principles in local approximation of density matrix formalism, the role of exchange nucleon-nucleon correlations in the process is investigated in detail. It is shown that correct account of the Pauli principle in scattering problem is especially important for the cases of α-particle rainbow scattering at large angles at the energy E/sub a/ >or approx. >100 MeV. 41 refs.; 11 figs.

6801 **(LBL—23929) Beta-delayed proton decay in the lanthanide region.** Nitschke, J.M.; Wilmarth, P.A.; Gilat, J.; Moeller, P.; Toth, K.S. (Lawrence Berkeley Lab., CA (USA); Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC03-76SF00098. 12p. (CONF-870970—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002232/JAW.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

A total of 24 new β-delayed proton precursors and several new decay branches in the region of $56 < Z < 72$ and $N < 82$ have been identified with the OASIS on-line mass separator facility at the SuperHILAC in Berkeley. Proton spectra and halflives were measured for all precursors. Additional properties determined for many of the isotopes include spins and parities of the precursors, final state feedings, proton branching ratios, (Q/sub EC/-S/sub p/) energy differences, and new levels in the proton decay daughters. Mixed β-delayed proton decay from precursor isomers and ground states has been observed. The proton decay has been compared to statistical model calculations using Gamow-Teller (GT) β-strength functions obtained from RPA calculations with Nilsson model wave functions. For the N = 81 precursors ^{151}Yb, ^{149}Er, and ^{147}Dy, pronounced structure in the proton spectra has been observed. An interpretation of this structure in the framework of "doorway" states is proposed. 25 refs., 6 figs., 1 tab.

6802 **Pion multiplicities in dynamical models of heavy ion collisions.** Gale, C. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2152-2154(Nov 1987).

The effects of different ingredients of time-dependent dynamical simulation models are investigated. The variable of interest is the net π^- production. I study the Ar+KCl data from E/sub lab/ = 0.36 to 1.808 GeV/nucleon with the momentum-dependent Boltzmann-Uehling-Uhlenbeck approach. Implications for the determination of the nuclear equation of state are mentioned and limitations of the model are considered.

6803 **Time-dependent Hartree—Fock method and chaos in nuclear dynamics.** Strayer, M.R. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **162**: No. 1, 157-173(30 Oct 1987). (CONF-8704193—). Contract AC05-84OR21400.

From Few-body systems and multiparticle dynamics conference; Crystal City, VA, USA (20 Apr 1987).

The long-time classical behavior of many-body systems is examined using time-dependent Hartree—Fock (TDHF) theory. Detailed computer simulations for the formation of a nuclear molecule in low-energy $^{12}C+^{12}C$ collisions are discussed at length. The representation of effective classical coordinates, and their correspondence to physical observable for systems which undergo large-amplitude quasi-periodic and chaotic motion is briefly summarized. The relationship between these calculations and new methods, which allow the calculation of quasiperiodic solutions to the TDHF equations under more general circumstances, is summarized.

6804 **s-s-bar separation during hadronization of a quark-gluon plasma.** Heinz, U.; Lee, K.S.; Rhoades-Brown, M.J. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). *Modern Physics Letters A;* **2**: No. 3, 153-158(Mar 1987). Contract AC02-76CH00016;AC02-76ER13001.

The authors present the equilibrium phase diagram for hadronic and quark matter containing strange particles and show quantitatively that at finite baryon density hadronization of quark-gluon plasma proceeds through a mixed phase in which s-bar-quarks hadronize first (as K/sup +/ and K/sup 0/ mesons) and s-quarks get enriched in the plasma subphase.

6805 **Collective azimuthal alignment in relativistic heavy ion reactions.** Beckmann, P.; Gustafsson, H.A.; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.; Loehner, H.; Poskanzer, A.M.; Ritter, H.G.; Schmidt, H.R.; Siemiarczuk, T. (Gesellschaft fur Schwerionenforschung, D-6100 Darmstadt). *Modern Physics Letters A;* **2**: No. 3, 163-168(Mar 1987).

The collective azimuthal alignment of charged particles is observed inside of two groups of particles, one emitted to the backward and one emitted to the forward hemisphere in the center of mass of symmetric heavy ion collisions. Whereas for Ca + Ca collisions no effect is observed, the alignment is present for Nb + Nb, and is even more pronounced for Au + Au. There exists also a distinct multiplicity and energy dependence of this collective azimuthal alignment.

6806 **Evidence for multiparticle correlations in high-energy heavy ion interactions.** Beckmann, P.; Doss, K.G.R.; Gustafsson, H.A.; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.; Loehner, H.; Poskanzer, A.M.; Ritter, H.G.; Schmidt, H.R. (Gesellschaft fur Schwerionenforschung, D-6100 Darmstadt). *Modern Physics Letters A;* **2**: No. 3, 169-176(Mar 1987).

An exclusive approach is proposed to study azimuthal multiparticle correlations in heavy ion interaction. Strong many-particle correlations are found in relativistic heavy ion reactions measured with the Plastic Ball spectrometer. Energy, mass, and multiplicity dependence of the correlations are examined.

6807 **Speed of sound in nuclear matter and Skyrme effective interactions.** Su, R.K.; Kuo, T.T.S. (Dept. of Physics, State Univ. of New York at Stony Brook, Stony Brook, NY 11794). *Modern Physics Letters A;* **2**: No. 2, 71-80(Feb 1987).

Using a nuclear equation of state derived from a finite-temperature Green's function method and the Skyrme effective interactions SkI, SkIII and SkM*, the authors have calculated the speed of sound in symmetric nuclear matter. For certain densities and temperatures, this speed is found to become super-luminous. Causal boundaries in the density-temperature plane are determined, and they indicate that SkM* is a more desirable effective interaction than SkI and SkIII. Comparison with a similar calculation by Osnes and Strottman is made.

6808 **Superheavy elements.** Seaborg, G.T.; Loveland, W. (Lawrence Berkeley Lab., CA, USA; Oregon State Univ., Corvallis, USA. Dept. of Botany). *Contemporary Physics;* **28**: No. 1, 33-48(Jan-Feb 1987).

The nuclear properties of superheavy nuclei are described. The problems involved in the laboratory synthesis of these elements are reviewed.

6809 **Searching for heavy neutral leptons.** Gilman, F.J. (Stanford Linear Accelerator Center, Menlo Park, CA, USA). *Comments on Nuclear and Particle Physics;* **16**: No. 5, 231-247(Nov 1986).

The motivation for searches for heavy neutral leptons is recalled. The status of such searches in high energy physics experiments is reviewed in the context of major improvements in detection sensitivity and the order of magnitude increase in mass range accessible experimentally.

6810 **Electromagnetic structure of nuclei.** Arnold, R.G. (The American University, Washington, DC 20016; Stanford Linear Accelerator Center, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 83-98(15 Oct 1986). (CONF-860575—). Contract AC03-76SF00515.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief review is given of selected topics in the electromagnetic structure of nucleons and nuclei for which significant progress was obtained in the two years since the last meeting in this series at Steamboat Springs Colorado.

6811 **Interacting Boson Model: Selected recent developments.** Balantekin, A.B. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 732-737(15 Oct 1986). (CONF-860575—). Contract AC05-84OR21400.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The Interacting Boson Model is briefly reviewed. Recent applications of this model to the low-lying collective magnetic-dipole excitations and to the spectra of /sup 195/Ir are described.

6812 **Piezonuclear fusion in isotopic hydrogen molecules.** Siclen, C.DeW.V.; Jones, S.E. (Idaho National Engineering Lab., Idaho Falls, USA). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 3, 213-221(Mar 1986).

A rough estimate is made of the rate of fusion of the nuclei in a deuterium molecule at room temperature and atmospheric pressure. As the density of the collection of molecules is increased, the fusion rate will likewise increase, in a manner given by an easily derived semi-classical equation. With sufficient experimental data, perhaps obtained through use of a diamond-anvil high-pressure cell, density-dependent expressions for the internuclear potentials of isotopic molecular hydrogen can be constructed and values for the corresponding fusion rates calculated.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 5820, 6360, 6361, 7016

6813 (FEI—1758) Systematic choice of mean free path in solution of problem of radiation deep transmission by Monte Carlo method. Aleshechkin, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700593/JAW.

Consideration is being given to technique and algorithm of systematic choice of mean free path for calculation of radiation deep transmission by methods of "splitting" and "reel". The method is realized on the basis of MMKGK program complex. Results of test calculations of neutron transport are presented (attenuation 10/ sup -8/-10/sup -16/). The advantages over "classical" method of surface "splitting" are shown. 10 refs.; 4 figs.; 4 tabs.

6814 (FEI—1787) Quasigroup approuch to solution of linear algebraic equation systems. Abramov, B.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700595/JAW.

The paper deals with some family of iterative nonstationary calculation algorithms of linear functional set determined with assigned accuracy on solutions of the system of linear algebraic equations occurring during numerical simulation of neutron, γ-quantum, heat transfer. These algorithms represent generalization of corresponding algorithms of neutron transfer theory, applied for approximation of energy dependences, therefore the considered approach is called as a quasigroup one. It is similar to the methods of convergence acceleration using enlarged grids, methods of variation synthesis etc. The suggested algorithms can be applied for solution of grid equation systems, typical for the problems of neutron transfer theory: as algorithms of energy group consolution, as algorithms of preparing effective factors of large grid, preserving the assigned functional set when passing from the problem on small grid, as algorithms of convergence acceleration of other iterative methods for solution of similar equations, etc. 8 refs.

6815 (FEI—1792) Effective model of elastic slowing-down in the Monte Carlo calculations. Korobejnikov, V.V.; Golovko, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700596/JAW.

Algorithm of refined calculation of neutron elastic slowing-down, based on the introduction of nuclide mixture effective mass and the detailed tracing of neutron energy in the process of its slowing-down. The algorithm developed is introduced into a modified version of calculation program for reactors and cells using the Monte Carlo method. The algorithm is tested using the calculations of fast critical assemblies and test model for the fast power reactor protection. Results of the Monte Carlo calculations are compared with calculations made using other programs. 4 tabs.

6816 (JINR—R-3-86-767) UCN reflection from matters with absorption large cross section. Golikov, V.V.; Kulagin, E.N.; Nikitenko, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700520/JAW.

The results on ultracold neutrons (UCN) reflection from strongly absorbing targets of /sup 155/Gd, /sup 155/Gd/sub 2/O/ sub 3/, Gd, Gd/sub 2/O/sub 3/, Cd ad /sup 113/Cd are reported. These data are well described in the frame of the UCN reflection theory introducing a complex index of refraction for the neutron waves. In the materials with a positive scattering wavelength the reflection index R first decreases with increasing absorption cross section, passes its minimum and then starts increasing againg. In the materials with a negative scattering wavelength one observes a monotonous growth of the reflection index with increasing absorption cross section. If the neutron velocity decreases the index of UCN reflection from a strong absorber such as /sup 155/Gd achieves a noticeable value much exceeding that of UCN reflection from a weak absorber such as vanadium (R/sub Gd//sup 155/=0.51 +- 0.05; R/sub V/=0.05 +- 0.03). 13 refs.; 5 figs.; 2 tabs.

6817 (LA-UR—87-3621) Use of the Chebyshev-Legendre quadrature set in discrete-ordinate codes. Walters, W.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-8702113—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001803/JAW.

From Computational methods in high temperature physics; Los Alamos, NM, USA (2 Feb 1987).

The Chebyshev-Legendre (C-L) quadrature set has been implemented in the neutron transport section of the TWODANT code. The C-L quadrature set has two advantages as compared to other quadrature sets. First, it is possible to easily generate S/sub N/ orders up to S_{100} with weights that are positive. TWODANT has been used to carry out calculations with as many as 10,000 discrete directions with the C-L quadrature set. Second, a product C-L set or order N will integrate exactly all the terms in the scattering source arising from P/sub N-1/ scattering. For example, the S_4 set will correctly integrate all scattering source terms if a P_3 scattering approximation is used. In TWODANT, users normally use the current S_8 quadrature set in the belief that P_3 scattering will be treated correctly. The S_8 set consists of some 40 directions and many times results in problem models that require excessive computer memory. The C-L S_4 set integrates exactly all the source terms associated with a P_3 expansion and consists of only 16 discrete directions. The results of test calculations, using both the current set and the C-L set in TWODANT, indicate that when high-order scattering is not significant, the two sets give answers that are in good agreement. 3 refs.

6818 (NIIAR—14(660)) Neutron gas transmission along the neutron guides. Kosvintsev, Yu.Yu.; Morozov, V.I.; Terekhov, G.I. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1985. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700742/JAW.

The ultracold neutron transmission has been studied using the cylindrical neutron guides made of copper and stainless steel of various geometries. A method has been developed and experimentally tested for calculation in the diffusion approach of the complex geometry neutron guide transmission. The performance of the horizontal transport neutron guides and the feasibility of their transmitting ability increase were analyzed. The unit is described intended for producing the ultra cold neutrons at the SM-2 reactor with the horizontal neutron guide of the high transmitting capability. 10 refs.; 11 figs.

6819 (PCCF-T—86-05) Production, detection and utilization of thermal neutron beams. Zaoui, F. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Oct 1986. 124p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750632/ JAW.

Based on an original 14 MeV neutrons beam, a thermal neutron beam is produced by slowing down the fast neutrons in a polythylen moderator. This thermal neutron beam is applied to neutroradiographic analysis of materials. A new type of electronic detector which consists of a microchannel plate (MCP) associated to a convertor made of Boron or Lithium is developed in order to reduce the exposure time of the samples while maintaining a good contrast. Neutroradiographies with (neutron, alpha) reactions of standard solutions of Boron-10 and Lithium-6 are realizad using Solid State Nuclear Tracks Detectors, and some parasite phenomenons are described. This method is applied to the two stable elements analysis in histological cross sections.

6820 Studies of the solution of a radiation transfer benchmark. Yobs, L.; Salter, J.M.; Lee, R.W. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 808 / L-23, Livermore, CA 94550). pp 324-332 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—). Contract W-7405-ENG-48.

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The radiative transfer benchmark which was defined previously is discussed in the light of the solution which uses the Equivalent Two-Level Atom Scheme to handle the multitransition aspects of the problem and Variable Eddington factors to assist in the solution of the transfer equation. Discussion is presented of the character of the benchmark solution. The solution exhibits slow convergence due to two distinct conditions. Further, a discussion is presented of two simplified solutions which attempt to accelerate the solution. Finally, correction to the previously published benchmark are presented in an appendix.

6821 SKYSHIN, a computer code for calculating radiation dose over a barrier. Atwood, C.L.; Boland, J.R.; Dickman, P.T. (Idaho National Engineering Lab., EG and G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415). pp 178-185 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—). Contract AC07-76ID01570.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

SKYSHIN is a computer code for calculating the radioactive dose (mrem), when there is a barrier between the point source and the receptor. The two geometrical configurations considered are: the source and receptor separated by a rectangular wall, and the source at the bottom of a cylindrical hole in the ground. Each gamma ray traveling over the barrier is assumed to be scattered at a single point. The dose to a receptor from such paths is numerically integrated for the total dose, with symmetry used to reduce the triple integral to a double integral. The buildup factor used along a straight line through air is based on published data, and extrapolated in a stable way to low energy levels. This buildup factor was validated by comparing calculated and experimental line-of-sight doses. The entire code shows good agreement to limited field data. The code runs on a CDC or on a Vax computer, and could be modified easily for others.

6550 Medical Physics

REFER ALSO TO CITATION(S) 5793, 5793, 6571, 6572

6822 (DOE/ER/60389—T1) [Neutron interactions with biological tissue: Progress report]. (National Bureau of Standards, Washington, DC (USA)). [1987]. Contract AI05-86ER60389. 18p. NTIS, PC A02. Order Number DE87013665/JAW.

This report describes a method for determining the deposition of energy by neutrons passing through tissue-like material. The analytical method developed here is compared to the more standard Monte Carlo methods using the same data base. Advantages of both systems are discussed. 19 refs., 6 figs. (TEM)

6823 (GSF—4/85) Dosimetry concepts and their use in radiation exposure in humans. Loester, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R.. Inst. fuer Strahlenschutz). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). 1986. 25p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751005/JAW.

An overview of dose concepts (ion doses, energy doses, equivalent doses, GSD, effective equivalent doses) and of radiation exposure of humans with an appendix dealing with the additional radiation exposure brought about by the Chernobyl accident.

6824 (KFKI—1987-39/K) Review of Monte Carlo techniques used in various fields of radiation protection. Koblinger, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1987. 31p. (CONF-870619—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700733/JAW.

From Application of computer technology to radiation protection; Bled, Yugoslavia (22 Jun 1987).

Monte Carlo methods and their utilization in radiation protection are overviewed. Basic principles and the most frequently used sampling methods are described. Examples range from the simulation of the random walk of photons and neutrons to neutron spectrum unfolding. 29 refs.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 5990, 6077, 6380, 6648, 6655, 6850

6825 (CONF-8705209—1) Electron localization in water clusters. Landman, U.; Barnett, R.N.; Cleveland, C.L.; Jortner, J. (Georgia Inst. of Tech., Atlanta (USA). School of Physics; Tel Aviv Univ. (Israel). School of Chemistry). 1987. Contract FG05-86ER45234. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000397/JAW.

From 20. Jerusalem symposium; Jerusalem, Israel (1 May 1987).

Electron attachment to water clusters was explored by the quantum path integral molecular dynamics method, demonstrating that the energetically favored localization mode involves a surface state of the excess electron, rather than the precursor of the hydrated electron. The cluster size dependence, the energetics and the charge distribution of these novel electron-cluster surface states are explored. 20 refs., 2 figs., 1 tab.

6826 (DOE/ER/45231—2) [Construction and operations of SUNY facilities at the national synchrotron light source]: Progress report, December 1, 1986-November 30, 1987. Coppens, P. (State Univ. of New York, Buffalo (USA)). 1987. Contract FG02-86ER45231. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002106/JAW.

The past year was the first in the existence of the SUNY PRT during which one beamline was almost continuously operational. The X21-A line was used for a series of experiments until the Phase II shutdown which started at the end of February 1987. Surface, Crystallographic and Small-Angle Scattering experiments were performed. During the last few months before the shutdown we were also able to start the first experiments on the X21-B line, which is specifically designed for surface studies. In the reporting period PRT members completed collection of three-dimensional data including satellite reflections at liquid-helium temperatures, which to our knowledge is the first anywhere with synchrotron radiation. Another first is the successful operation of a single-crystal diamond-anvil cell at elevated temperatures. Our small angle scattering beamline is unique in the SAXS field in having optics which are both focussing and allow wavelength-scanning. Approximately 32 SUNY faculty, students and staff were involved in the studies. 25 faculty, students and scientific staff from 11 other universities and institutions collaborated in the various research projects. The multi-purpose nature of our beamline has attracted considerable attention. In the coming year, for example, we will be hosting a scientist from the Beijing PRC synchrotron lab, who will be sent here by the PRC to familiarize himself with our design. A short desription is given of the beamlines and their use during the reporting period. A description of each of the experiments is also provided.

6827 (FRNC-TH—3060) Contribution to study of iron implantation in garnets by transmission electron microscopy. Ravel, F. (Grenoble-1 Univ., 38 (France)). Oct 1986. 174p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750640/JAW.

Slowing phenomena of ions in matter are described; impurity profiles deduced from LSS theory in the case of Y/sub 3/Al/sub 5/O/sub 12/, Y/sub 3/Fe/sub 5/O/sub 12/, Gd/sub 3/Ga/sub 5/O/sub 12/ are presented. Theoretical distribution of implantation defects in the three materials is researched, so as to correlate them with the experimental ones. Transmission electron microscopy is described. Defaults generally observed in these oxides are recalled. Observation techniques developed to study iron implantation in the above compounds are described. The other characterization techniques associated with the TEM are briefly described. Results in the /sup 57/Fe implanted Y/sub 3/Al/sub 5/O/sub 12/ case are presented. Dose and annealing temperature effects on structure are studied. Results of a growing kinetic study are presented. The /sup 57/Fe implanted Gd/sub 3/Ga/sub 5/O/sub 12/ case is specifically presented. Differences observed with the Y/sub 3/Al/sub 5/O/sub 12/ case are insisted upon. The /sup 57/Fe implanted Y/sub 3/Fe/sub 5/O/sub 12/ case is just recalled: overstoechiometric iron behavior leads to Morin temperature variations of αFe/sub 2/O/sub 3/ that we tentatively explain by structural considerations.

6828 **(IPP—9/54) Self-sputtering and reflection.** Eckstein, W. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1985. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750545/JAW.

Self-sputtering and reflection are investigated with the Monte Carlo program TRIMSP. The results include particle and energy reflection coefficients, sputtering yields and sputtered energy versus incident angle and energy. Angular and energy distributions of reflected and sputtered particles are also given. Reflection and sputtering values are compared to show their contributions to selfsputtering. A comparison of calculated sputtering yields and sputtering efficiencies (sputtering energy) with experimental data is carried out. The systems investigated are mainly the bombardment of C, Ni, and W with self-ions.

6829 **(JINR—R-3-86-791) Study of inelastic neutron scattering on ZrH/sub x/(D/sub x/) with DIN-2PI spectrometer.** Bascoveanu, I.; Kozlov, Zh.A.; Padureanu, I.; Rapeanu, S.; Rotaresku, G.; Semenov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700521/JAW.

The results of the measurements performed by inealstic neutrons scattered on ZrD/sub 1,6/, and ZrD/sub 2/ at the IBR-2 reactor are presented. The frequency spectra for ZrD/sub 2/ and ZrH/sub 2/ are used to calculate the specific heat. A theoretical interpretation of the experimental results in terms of an improved theoretical model based on central force potential is given. 18 refs.; 6 figs.

6830 **(JINR—R-14-86-594) Study of Bridgman phases of CCL/sub 4/ model molecular crystal with the time-of-flight neutron diffractometer.** Balagurov, A.M.; Beskrovnyj, A.I.; Savenko, B.N.; Sangaa, D.; Alikhanov, R.A.; Ivanov, A.N.; Smirnov, L.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700554/JAW.

Neutron diffraction study of Bridgman's phases of CCl/sub 4/ has been performed with a time-of-flight diffractometer. In order to achieve high pressure a cell of cylinder-piston type was used. The cell has 120 deg horizontal window, the inside part of the cell was made of Ti-Zr alloy having the neutron, coherent scattering amplitude is equal to zero. The diffraction spectra at room temperature and pressure up to 11 kbar were measured by position-sensitive detector at 1-10 A neutron wave-length interval and ~ 10 deg scattering angle interval. The middle scattering angle was changed from 25 deg to 80 deg. Such mode of spectrum measurement allowed one to observe the creation of CCl/sub 4/ single crystal with large blocks, polycrystallization of a sample during the phase boundary crossing and the appearance of texture. The diffraction spectrum of phase 3 CCl/sub 4/(P≧7 kbar) is in good agreement with the data available. 19 refs.; 6 figs.; 1 tab.

6831 **(JINR—R-17-86-761) Inelastic neutron scattering in glasses.** Vujicic, G.M.; Stamenkovic, S.S.; Plakida, N.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700556/JAW.

A model of glass is considered where in addition to the acoustic phonons strongly anharmonic low-frequency quasilocal vibrations (QLV) are taken into account. A general expression for the inelastic-scattering cross section is obtained and the cross sections due to the phonons and QLV are evaluated. It is shown that in the low-frequency range (2-3 MeV) both the contributions are of the same order even for a low concentration (~ 10/sup -4/) of QLV. 14 refs.

6832 **(KFKI—1987-41/E) Evidence of antiferromagnetic ordering in La/sub 2/CuO/sub 4/: re-interpretation of /sup 139/La nuclear quadrupole resonance (NQR) data.** Furo, I.; Janossy, A. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700735/JAW.

A re-interpretation of the result of recent /sup 139/La nuclear quadrupole resonance measurements on La/sub 2/CuO/sub 4/ reveals an antiferromagnetic order in this material at low temperature. The magnitude and the direction of the local field at the La places are calculated. Supposing localized moments on copper atoms as the source of the magnetic field it is shown that the ordering of magnetic moments on copper sites is not the simplest 'chessboard' antiferromagnetic type. 8 refs.

6833 **(KFTI—86-15) Gamma radiation at the 970 MeV plane positron channeling in diamond crystals.** Ganenko, V.B.; Noga, V.I.; Pegushin, E.V.; Sanin, V.M.; Semisalov, I.L. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700557/JAW.

Measurements of gamma spectra of 970 MeV positrons during motion over the crystallographic plane (100) in 0.3 and 2 mm thick diamond monocrystals without γ-quantum beam collimation and with weak collimation are conducted. Calculations of emission spectra satisfactorily describing experimental data and permitting to evaluate the ratio of channeling positrons; 25% for thin and 8% for thick diamond crystals are performed. Approximate estimation of postron dechanneling length of ~ 0.5 mm is obtained. 10 refs.; 1 fig.

6834 **(KFTI—86-16) Effect of irradiation on the diffusion evolution of void ensemble in crystals.** Dubinko, V.I.; Ostapchuk, P.N.; Slezov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700558/JAW.

Irradiation of crystals containing voids is shown to result in "radiation coalescence": accelerated growth of voids with the radius exceeding the medium one at the expense of dissolving smaller voids. Tendency of voids to interstitial absorption inversely proportional to the radius of the voids is the main physical reason for distribution dimensions. The function of void distribution by their dimensions at high radiation doses is shown to aquire universal form independent from initial conditions. In this case the suggested theory is similar to the L-S theory of diffusion decomposition of oversaturated solid solutions but in contrast to the latter radiation intensity plays the role of temperature and the energy of void interaction with point defects appears as surface energy. The rate of "radiation coalescence" may be several orders higher than that of "thermal coalescence". 11 refs.

6835 **(KFTI—86-26) Change of europium crystallographic symmetry at helicoidal magnetic ordering.** Bulatov, A.S.; Kovalev, O.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700559/JAW.

The effect of arising strong tetragonal tendency in europium bcc lattice at helicoidal magnetic ordering is stated experimentally. The group theory analysis discloses presence of exchange magnetoelastic invariants characteristic only for a spiral phase. A large number of them bring about noticeable crystal deformation over the helicoid axis. 14 refs.; 2 figs.; 3 tabs.

6836 **(KFTI—87-4) Wave functions for bound states of relativistic electrons in a crystal at electron movement along crystallographic planes.** Morokhovskij, V.L. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700563/JAW.

The algorithm for calculating wave functions of bound states of relativistic electrons in the crystal potential averaged along a crystallographic plane is described. Numerical calculations on BESM-6 computer of wave functions of electrons with 20 MeV energy moving in a diamond crystal along the plane (100) are given. 3 refs.; 2 figs.

6837 **(LA-UR—87-3333) The Frenkel-Kontorova model with nonconvex interparticle interactions.** Marianer, S.; Bishop, A.R.; Pouget, J. (Los Alamos National Lab., NM (USA); International Centre for Theoretical Physics, Trieste (Italy)). 1987. Contract W-7405-ENG-36. 6p. (CONF-8705168—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001849/JAW.

From Workshop on competing interactions and microstructures: statics and dynamics; Los Alamos, NM, USA (5 May 1987).

A study is presented of the ground state and excitations of the Frenkel-Kontorova model with nonconvex interparticle interactions, emphasizing the special effects of the nonconvexity on the ground state and on the excitations. This study has been limited to nonconvexity with two competing length scales. 10 refs., 3 figs.

6838 **(LA-UR—87-3471) Statistical properties of Lorentz lattice gases.** Binder, P.M. (Los Alamos National Lab., NM (USA); Yale Univ., New Haven, CT (USA). Dept. of Applied Physics). 1986. Contract W-7405-ENG-36. 18p. (CONF-8610281—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001788/JAW.

From Modern approaches to large nonlinear physical systems workshop; Santa Fe, NM, USA (27 Oct 1986).

In this paper we present new results for the long-time tails and mean-square displacement evolution for several deterministic and probabilistic models of the Lorentz gas in a square lattice. The simulations give diffusion coefficients which agree with analytical results from the corresponding Boltzmann equation. For long times, abnormal diffusion is observed for the deterministic models only. This is probably due to recurring trajectories. The velocity autocorrelation function shows exponents which vary between -1 and -2 depending on the particle-scatterer collision model used. 23 refs., 7 figs.

6839 **(LBL—23894) A periodic small-cluster approach to many-body problems.** Falicov, L.M. (Lawrence Berkeley Lab., CA (USA); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Aug 1987. Contract AC03-76SF00098. 8p. (CONF-8708158—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002235/JAW.

From 5. international conference on the recent progress in the many-body theories; Oulu, Finland (3 Aug 1987).

Many-body problems can very seldom be solved exactly, and their study normally requires approximate methods. These approximations are of various kinds and accuracy, but usually they involve either a perturbation treatment, or a variational approach. The method employed also depends on whether the problem under study is a real or realistic system or a prototype, ideal model. The method proposed by the author and used with his collaborators in the solution of a variety of problems consists of taking explicit advantage of finite sampling, finite cluster duality. By a systematic, symmetric and wise choice of N points in reciprocal space, the problem can be reduced to that of a symmetric periodic cluster with N sites. If, in addition, N is small enough - as is the case in the normal handling of perturbation expansions - the problem can then be solved exactly, without recourse to perturbation methods. With the aid of group theory, only modest computer facilities are required. A similar approach has been taken by Callaway and his collatorators. 56 refs.

6840 **(N—87-28430) Activities of the Solid State Physics Research Institute. Annual report, 1 January-31 December 1985.** (Virginia State Univ., Petersburg (USA)). Dec 1985. 70p. (NASA-CR—181255; NAS—1.26:181255). NTIS, PC A04/MF A01.

Topics addressed include: muon spin rotation; annealing problems in gallium arsenides; Hall effect in semiconductors; computerized simulation of radiation damage; single-nucleon removal from Mg-24; and He-3 reaction at 200 and 400 MeV.

6841 **Physics reviews. Volume 7.** Khalatnikov, I.M. New York, NY; Harwood Academic Pub. (1986). 312p. Harwood Academic Pub., P.O. Box 786, Cooper Station, New York, NY 10276.

This book is comprised of articles on localization in disordered systems, the theory of liquid crystals, the problems of the interaction of laser irradiation with matter, etc. It covers a number of problems of the modern theory of electron localization. The author formulates the general principles, making it possible to find the criterion of localization and the associated instability effects. He also studied the influence of localization on physical properties of disordered systems. The book also discusses the influence of fluctuation effects on the dynamics of liquid crystals. It is shown that the nonlinear effects of the interaction of fluctuations in liquid crystals also plays an essential role in the absorption of sound and affects the hydrodyamics of such systems. In the paper on "Conduction Electron Surface Spin-Flip Scattering and Resonance Phenomena in Metals" the author has developed a consistent approach to the study of the role of surfacial scattering with spin flip in the kinetics of spin magnetization of conduction electrons in metals.

6561 Superconductivity

REFER ALSO TO CITATION(S) 5989, 6034, 6044, 6047, 6048, 6086

6842 **(AD-A—184208/7/XAB) Superconductivity as a synchronous spatial alternation of valence bonds. Technical report.** Messmer, R.P. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Apr 1987. 13p. (TR—6). NTIS, PC A02/MF A01.

A new theoretical model for superconductivity is proposed that depends on a pairing in real space (valence bonds). Pair-pair correlations establish an ordered array of such pairs and a synchronous alternation among equivalent coherent spatial arrays of valence bonds is considered as the origin of superconductivity. Simple metals with low-valence electrons (e.g., Be, Zn, etc.) are used to illustrate the ideas. The new high T/sub c/ materials (based on substitutions in La_2CuO_4) will be considered elsewhere.

6843 **(AD-A—184274/9/XAB) Valence bond theory and superconductivity. Technical report.** Messmer, R.P.; Murphy, R.B. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Jun 1987. 17p. (TR—7). NTIS, PC A02/MF A01.

Two necessary criteria for a theory of superconductivity are a phase coherence of the wave function and an attractive electron-electron interaction. How the BCS theory achieves these criteria is first reviewed, after which it is shown how a valence-bond wave function can also meet these conditions. The energy scale of the latter approach has a larger range in principle than that possible via the electron-phonon interaction.

6844 **(AD-A—184275/6/XAB) Chemical bond and superconductivity. Technical report.** Messmer, R.P. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Jul 1987. 23p. (TR—8). NTIS, PC A02/MF A01.

The search for understanding of the physical mechanisms operating in the recently discovered high-T/sub c/ superconductors forces a re-examination of the basic concepts and physical assumptions of current theoretical approaches. The attractive interaction of a more-general theory may be rather more complicated than

the electron-phonon interaction usually assumed. In fact, it probably contains the critical chemical parameters of the material. This is the motivation for the present work in which the focus is twofold: first, to call attention to some recent developments in our understanding of the chemical bond, and second, to prepose that this new understanding is not only germane to the electronic structure of solids but also provides a new perspective on the relationship between the chemical bond and superconductivity. Studying the connection between chemical bonding and superconductivity would seem to be rather an academic exercise if it were not for the high-temperature superconductors. These materials have brought attention in a dramatic fashion to the ignorance that exists in relating chemistry to the important physical parameters of a superconductor. Although this point was raised in numerous contributions by Matthias, its full import was never so apparent when the superconductors were traditional metals and alloys.

6845 (IAE—4345/10) Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition. Sotnikov, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700603/JAW.

Behaviour of the bound system consisting of a superconducting sample and measuring coil is analyzed in the process of sample transition from the normal state to superconducting one proceeding from general electrodynamics laws. Formally, such a process is shown to be described by appearance of "imaginary induction". Analytical expressions for the amplitude and signal phase are obtained for the case of using a simple bridge circuit when measuring. It is turned out that the substantial factor determining the form of superconducting transition obtained in the experiment (at the given dependence of sample resistance on the temperature) is the ratio between the effective sample resistance in the normal state and its induction. 6 refs.; 8 figs.

6846 (LBL—23679) Macroscopic quantum effects in a Josephson tunnel junction. Clarke, J.; Cleland, A.N.; Devoret, M.H.; Esteve, D.; Martinis, J.M. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 13p. (CONF-8705117—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002239/JAW.

From 9. international conference on noise in physical systems; Montreal, Canada (25 May 1987).

This paper discusses the observation of quantum effects in the macroscopic system of a Josephson tunnel junction. The macroscopic degree of freedom is the phase difference δ between the phases of the order parameters in the two superconductors on either side of the tunnel barrier. As we shall see, the anharmonicity enables us to observe the quantized energy levels because they are no longer equally spaced, and to observe the zero point motion by the demonstration that the system tunnels out of its initial state. 6 refs., (LSP)

6847 (LBL—23876) Quantum phenomena in superconductors. Clarke, J. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 8p. (CONF-870873—18). NTIS, PC A02. Order Number DE88002238/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

This paper contains remarks by the author on aspects of macroscopic quantum phenomena in superconductors. Some topics discussed are: Superconducting low-inductance undulatory galvanometer (SLUGS), charge imbalance, cylindrical dc superconducting quantum interference device (SQUIDS), Geophysics, noise theory, magnetic resonance with SQUIDS, and macroscopic quantum tunneling. 23 refs., 4 figs. (LSP)

6848 (SAND—87-2175C) Atomic-level studies of superconducting YBa_2Cu_3O/sub 7-x/. Kellogg, G.L.; Brenner, S.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871178—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002522/JAW.

From Thin film processing and characterization of high temperature superconductors; Anaheim, CA, USA (6 Nov 1987).

The transmission electron microscope, field ion microscope, and imaging atom-probe mass spectrometer have been used to examine the structure and composition of field-emitter "tips" prepared from hot-pressed samples of YBa_2Cu_3O/sub 7-x/. Transmission electron microscope images of the tip apex clearly show periodic defect structures which are interpreted as twins boundaries. Field ion microscope images reveal the structure of the samples in atomic resolution and indicate that the material can be field evaporated in a uniform, layer-by-layer fashion. Imaging atom-probe mass spectra contain signals corresponding to all of the constituent elements with intensities fairly consistent with the 1-2-3 ratio of the metals, but highly deficient in oxygen.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 6260, 6593, 6741, 6787, 6839

6849 (CBPF-NF—054/86) On the physical problem of spatial dimensions: an alternative procedure to stability arguments. Caruso, F.; Xavier, R.M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700575/JAW.

The three-dimensionality of space as a physical problem is discussed. Consideration on previous works is done, in which it is showed that the n-dimensional solar system can be stable only for n=3 and, from quantum mechanics, that this is the case also for hydrogen atons. Thus the epistemological consequences of the use of the stability postulate to derive spatial dimensionality is critically reviewed. The distinguished role of Maxwell's eletromagnetic theory in the determination of space dimensionality is stressed. 'Metric versus' 'topological' 'arguments are compared and shown to apply respectively to 'matter' and 'fields'. (G.D.F.).

6850 (CONF-8703205—1) n-point Green's functions in the Anderson model. Mancini, F.; Marinaro, M.; Nakano, Y. (Salerno Univ. (Italy). Dipartimento di Fisica Teorica). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900064/JAW.

From 27. Sanibel symposium; Marineland, FL, USA (16 Mar 1987).

This paper develops Hamiltonians for the Anderson model of conduction electrons. The Hamiltonians are solved exactly using Green's Functions. 8 refs. (JDH)

6851 (IAE—4274/12) Highly exact variational solutions of the three-body Coulomb problem. Frolov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700600/JAW.

Calculational problems of bound states of three-particle Coulomb systems are considered. The calculation results of levels in atomic, mesomolecular and molecular systems are given. The method for deriving formulae for L=0, L=1, L=2 states is described. Difficulties occurring when calculating bound states of the systems in methods for relative coordinates are analysed. 38 refs.; 7 tabs.

6852 (ITEF—95(1986)) Invariant simulation and invariant imbedding of vector fields. Petukhov, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700683/JAW.

Simulation of a vector field invariant under the full geometric group of symmetries by another one is considered. The structure of multipole force lines and the so-called quasicharges (of the Dirac monopole type) is studied from this viewpoint. Invariant imbedding of vector fields is used for decoration structures of correct parquets on the plane and other two-dimensional manifolds by vector lines. Extention to higher varieties, to discrete fields is discussed.

6853 **(ITEP—79(1986)) Relativistic ls-coupling in scalar potential.** Martem'yanov, B.; Shchepkin, M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700700/JAW.

The relative LS-coupling is calculated quasiclassically for Dirac particle moving in scalar potential. It is shown that relativistic quantum mechanics reproduces classical equations of precession with Thomas frequency for large orbital excitations. It is important that the spin-orbit shift of levels is (for relativistic rotation) γ times larger than the splitting of rotational levels ($\gamma=1/\sqrt{1-v/sup\ 2/}$). Spin-1/2 particle as an example is considered. 8 refs.

6854 **(JINR—R-5-86-800) Stability of solutions of solitary wave type for Korteweg - de Vries generalized equation.** Zhidkov, P.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700528/JAW.

Using the Lions concentration-compactness method the form stability of solitonlike solutions for Korteveg - de Vries generalized equation with u/sup ν/u/sub x/ nonlinearity in one-dimensional geometry is investigated. Earlier the analogous investigations were carried out for the Korteveg - de Vries equations and for the modified Korteveg - de Vries equation. The stability region coincides with the $0 < \nu < 4$ interval. 17 refs.

6855 **(JINR-R—2-86-148) On the dynamical supersymmetry of atomic hydrogen.** Slepchenko, L.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700713/JAW.

In the framework of supersymmetric quantum mechanics a dynamical symmetry of the hydrogen atom is considered. New features of spectra for the dynamical supersymmetry of two-dimensional Kepler problem are found. 10 refs.; 1 fig.

6856 **(JINR-R—2-86-819) Soliton evolution in a nonlinear integrable system.** Mel'nikov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700717/JAW.

Submitted to the journal Lett. Math. Phys. .

Solutions with asymptotics of the one-soliton type as t -> +- ∞ are found in a nonlinear integrable system. However, sets of essential parameters of these solitons are different, i.e. solutions describe evolution of a soliton with one set of parameters into a soliton with another set of parameters. The results presented here are obtained by the inverse scattering method and are relevant to some problems of hydrodynamics, plasma physics, etc. 3 refs.

6857 **(LAPP-TH—181) BRS symmetry of supergravity in superspace and its projection to component formalism.** Baulieu, L.; Bellon, M.; Grimm, R. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Dec 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750635/JAW.

The BRS symmetry of supergravity theories is geometrically constructed in superspace. The construction is formally identical to the one which holds for gauge theories coupled to gravity. If the classical superspace constraints associated to a given set of auxiliary fields are known it is immediate to obtain by projection the whole set of BRS transformation laws in component formalism. We illustrate the method with various representations of N=1, D=4 Poincare supergravity. In particular we consider couplings to Chern-Simons forms. Our analysis proves the absence of U(1) anomaly in the new minimal supergravity for any coupling of matter fields.

6858 **(LPC—86-19) Oblique photon expansion of QED structure functions.** Chahine, C. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750636/JAW.

In the oblique photon expansion, the collinear part of photon emission is summed up to all orders in perturbation theory. The number of oblique or non-collinear photons is the expansion order. Unlike in perturbation theory, every term of the expansion is both infrared finite and gauge invariant. The zero oblique photon contribution to the electromagnetic structure tensor in QED is computed in detail. The behaviors of the structure functions F1 and F2 are discussed in the soft and ultra-soft limits.

6859 **(N—87-28358) Convergence of spectral methods for nonlinear conservation laws. Final report.** Tadmor, E. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Aug 1987. 24p. (NASA-CR—178352; ICASE—87-54; NAS—1.26:178352). NTIS, PC A02/MF A01.

The convergence of the Fourier method for scalar nonlinear conservation laws which exhibit spontaneous shock discontinuities is discussed. Numerical tests indicate that the convergence may (and in fact in some cases must) fail, with or without post-processing of the numerical solution. Instead, a new kind of spectrally accurate vanishing viscosity is introduced to augment the Fourier approximation of such nonlinear conservation laws. Using compensated compactness arguments, it is shown that this spectral viscosity prevents oscillations, and convergence to the unique entropy solution follows.

6860 **(UFPB-DF—01/86) Ad-hoc first integrals for the equation q/sup ../+A/sub 2/(q,t)q/sup .2/+A/sub 1/(q,t)q/sup ./+A/sub 0/(q,t)=0.** Farias, J.R. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700745/JAW.

First integrals for the equation q/sup ../+A/sub 2/(q,t)q/sup .2/+A1 (q,t)q/sup ./+A/sup 0/(q,t)=0 are found without the use of conventional techniques

6861 **(UFPB-DF—04/86) 'Hamiltonization' as a two-fold procedure.** Espindola, M.L.; Espindola, O.; Teixeira, N.L. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700746/JAW.

It is shown that usual Hamiltonian formalism is based on a choice about the solution of a differential equation. This choice is the singular (envelope) solution. The alternative choice implied is a linear Hamiltonian in the momenta variables. Both are canonical description of the same mechanical system.

6862 **(UFPB-DF—08/86) Time-dependent harmonic oscillators and squeezed states.** Pedrosa, I.A. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700747/JAW.

Utilizing time-dependent operators whose associated states are squeezed states, it is shown that the general time-dependent harmonic-oscillator Hamiltonian belongs to the class of quadratic Hamiltonians that generate squeezed states. An illustrative example is also considered.

6863 **(UFPB-DF—14/85) On the eigenvalues of S.PI for arbitrary spin in a constant magnetic field.** Jayaraman, J.; Oliveira, M.A.B. de. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1985. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700750/JAW.

Utilizing the intimate connection of a charged particle in a nomogeneous magnetic field to that of a harmonic oscillator, it was established in a recent communication that the eigenvalue spectrum of the matrix operator S.PI for spin 1 is purely real for any intensity of the external magnetic field thereby removing a false impression to the contrary in the recent literature. Here these results are extended to arbitrary spin the reality of the eigenvalue spectrum. The case of spin 3/2 is discussed in some details and it is demonstrated that the complex eigenvalues implied the spectrum by a recent analysis of Weaver, for sufficiently intense magnetic field, when the particle number n assumes values 0 and 1 do not in fact appear at all.

6864 **Continuum-regularized quantum gravity.** Chan Huesum; Halpern, M.B. (Lawrence Berkeley Lab., CA, USA; California Univ., Berkeley, USA. Dept. of Physics). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* 36: No. 4, 669-693(Nov 1987). Contract AC03-76SF00098.

The recent continuum regularization of d-dimensional Euclidean gravity is generalized to arbitrary power-law measure and studied in some detail as a representative example of coordinate-invariant regularization. The weak-coupling expansion of the theory illustrates a generic geometrization of regularized Schwinger-Dyson rules, generalizing previous rules in flat space and flat superspace. The rules are applied in a non-trivial explicit check of Einstein invariance at one loop: the cosmological counterterm is computed and its contribution is included in a verification that the graviton mass is zero.

6865 **Cluster separability in front-form particle dynamics.** Coester, F. (Physics Div., Argonne National Lab., Argonne, IL 60439-4843). pp 159-170 of Contraint's theory and relativistic dynamics. Longhi, G.; Lusanna, L. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8605176—).

From International workshop on constraint's theory and relativistic dynamics; Florence, Italy (28 May 1986).

A demonstration is given of the existence and the explicit construction of a relativistic front-form many-body dynamics.

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6866 **(AD-A—184206/1/XAB) Variable-collision-frequency effects on hose and sausage instabilities in relativistic electron beams. Memorandum report.** Slinker, S.P.; Hubbard, R.F.; Lampe, M. (Naval Research Lab., Washington, DC (USA)). 12 Aug 1987. 43p. (NRL-MR—6004). NTIS, PC A03/MF A01.

A relativistic electron beam propagating in a dense gas typically ionizes the gas weakly, and the resulting plasma conductivity evolution strongly influences beam-stability properties. The electric field E and the plasma electron temperature T/sub e/ usually decrease with the distance zeta behind the beam head; as a result, the plasma electron-neutral collision frequency Nu sub m decreases with zeta, which depresses the conductivity sigma in the front of the beam and increases sigma further back in the beam. This variation of nu sub m, which has generally been ignored in previous models, substantially modifies beam instability evolution. Hose instability growth tends to increase very rapidly in the beam head and taper off to an asymptotic value for large zeta in contrast to the pure power law growth seen when d(sigma)/d (zeta) are assumed to be constant. A second effect arises from local decreases in the perturbed conductivity sigma I produced by perturbed electric field-driven increases in the local collision frequency. This destabilizing effect causes the beam to behave as if the monopole conductivity sigma sub 0 were replaced. Analytical models for the case of constant perturbation illustrate the pattern of rapid hose instability growth in the beam head followed by a plateau in hose amplitudes that is also observed in hose simulations with the VIPER model. The destabilizing effect of variable nu/sub m/ on the perturbed conductivity also occurs for the resistive sausage instability. However, the model calculation presented here shows that the threshold for sausage instability is not likely to be reached for reasonable beam and plasma parameters.

6867 **(AD-A—184299/6/XAB) Ballooning modes or Fourier modes in a toroidal plasma.** Connor, J.W.; Taylor, J.B. (UKAEA Culham Lab., Abingdon). Jan 1987. 26p. (CLM-P—797). NTIS, PC A03/MF A01.

The relationship between two different descriptions of eigenmodes in a torus is investigated. In one, the eigenmodes are similar to Fourier modes in a cylinder and are highly localized near a particular rational surface. In the other, they are the ballooning modes that extend over many rational surfaces. A model that represents both drift waves and resistive interchanges is used to investigate the transition from one of these structures to the other. In this simplified model the transition depends on a single parameter that embodies the competition between toroidal coupling of Fourier modes (which enhances ballooning) and another (which diminishes ballooning). As the coupling is increased, each Fourier mode acquires a sideband on an adjacent rational surface and these sidebands then expand across the radius to form the extended mode described by the conventional ballooning-mode approximation. This analysis shows the ballooning approximation is appropriate for drift waves in a tokamak but not for resistive interchanges in a pinch. In the latter the conventional ballooning effect is negligible but they may nevertheless show a ballooning feature. This is localised near the same rational surface as the primary Fourier mode and so does not lead to a radially extended structure.

6868 **(DOE/ER/53182—1) Tandem mirror trapped particle instability: Final report, May 1, 1984 to July 31, 1987.** Sen, A.K.; Scarmozzino, R.; Navratil, G.A. (Columbia Univ., New York (USA)). Sep 1987. Contract FG02-84ER53182. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002547/JAW.

The Columbia Linear Machine has been redesigned to enter the parameter regime of the collisionless, curvature-driven, trapped-particle instability. With the new machine configuration, a strong ($n/N > 60\%$), coherent mode is observed which bears all the characteristics of this instability. These include strong localization to the mirror cell, broad radial-mode structure, and MHD-like body motion of the plasma column. Furthermore, the mode exhibits all the correct parametric dependences of increasing mode amplitude with increasing mirror ratio and rf power, and decreasing mirror-cell length.

6869 **(DOE/ER/53220—T2) Plasma theory and simulation: Third and fourth quarterly progress report, July 1, 1986-December 31, 1986.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 1986. Contract FG03-86ER53220. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000412/JAW.

Our group uses theory and simulation as tools in order to increase the understanding of plasma instabilities, heating, transport, plasma-wall interactions, and large potentials in plasmas. We also work on the improvement of simulation both theoretically and practically. Two separate papers are included in this report.

6870 (DOE/ER/53220—T2, pp 18-46) **Performance and optimization of direct implicit time integration schemes for use in Electrostatic Particle Simulation Codes.** Procassini, R.J.; Birdsall, C.K.; Morse, E.C.; Cohen, B.I. (Lawrence Livermore National Lab., CA). 1986. NTIS, PC A04/MF A01. Order Number DE88000412/JAW.

In Plasma theory and simulation: Third and fourth quarterly progress report, July 1, 1986-December 31, 1986.

Implicit time integration schemes allow for the use of larger time steps than conventional explicit methods, thereby extending the applicability of kinetic particle simulation methods. This paper will describe a study of the performance and optimization of two such direct implicit schemes, which are used to follow the trajectories of charged particles in an electrostatic, particle-in-cell plasma simulation code. The direct implicit method that was used for this study is an alternative to the moment-equation implicit method. 10 refs.

6871 **(DOE/ER/53244—1) [Reversed field pinch experiments]: Summary of progress report.** Robertson, S. (Colorado Univ., Boulder (USA)). 1987. Contract FG02-87ER53244. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002367/JAW.

The purpose of the Reversatron experiment is to determine the role of the shell in Reversed Field Pinch (RFP) confinement. In 1987 three experimental studies were completed: a study of the RFP operated as a spheromak of high aspect ratio, a study of a modular shell, and a study of dynamo activity in ultra-low-q tokamak discharges. In addition, a new "front end" for the Reversatron

experiment has been constructed and is ready for testing. These experimental studies are summarized in this report.

6872 **(DOE/ET/51013—210-Rev.) Visible continuum measurements on the Alcator C Tokamak: Changes in particle transport during pellet fuelled discharges.** Foord, M.E. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Dec 1986. Contract AC02-78ET51013. 159p. (PFC/RR—87-2-Rev.). NTIS, PC A08. Order Number DE88002293/JAW.

A spatially resolving visible light detector system is used to measure continuum radiation near 5360A on the Alcator C Tokamak. For the typically hot plasmas studied, the continuum emission is found to be dominated by bremsstrahlung radiation near this wavelength region. Accurate determinations of Z/sub eff/ are obtained from continuum measurements using independently determined temperature and density measurements. Density profiles during high density, clean pellet fueled discharges, are also determined and are used to study the changes in particle transport after injection. For discharges with sufficiently large pellet density increases, density profiles are found to become more peaked following the injection. In these cases, the profiles are found to remain peaked for the remainder of the discharge, or until a "giant" sawtooth or minor disruption abruptly returns the profiles to a flatter pre-pellet condition. Analysis of density profiles after pellet injection yields information about the radial diffusion and convection velocity of the plasma particles. The peakedness in the density profiles, observed after pellet injection, is attributable mostly to increases in inward convection. It is concluded that neoclassical fluxes are too small to account for these changes. 70 refs., 55 figs.

6873 **(DOE/ET/51013—229) Feasibility of ion temperature measurement with a gyrotron scattering alpha particle diagnostic.** Woskoboinikow, P.P.; Cohn, D.R.; Maschuzak, J.S.; Myer, R.C.; Rhee, R.Y. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1987. Contract AC02-78ET51013. 9p. (PFC/CP—87-13; CONF-871210—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001914/JAW.

From 12. annual international conference of the Institute of Electrical and Electronics Engineers on infrared and millimeter waves; Orlando, FL, USA (14 Dec 1987).

Collective Thomson scattering can be used to diagnose localized ion temperature as well as alpha particle velocity distribution and density in a D-T burning tokamak. With one diagnostic beam a simultaneous, but independent, measure of the bulk ion temperature and alpha particle parameters can be made. Use of a long pulse, millimeter-wave gyrotron offers a significant margin in signal to noise ratio capability ($\sqrt{\Delta}$ftau $>$ 1000) not previously possible with lasers. 9 refs., 2 figs.

6874 **(DOE/ET/53088—302) Relation of wave energy and momentum with the plasma dispersion relation in an inhomogeneous plasma.** Berk, H.L.; Pfirsch, D. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Oct 1987. Contract FG05-80ET53088. 30p. (IFSR—302). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002305/JAW.

The expressions for wave energy and angular momentum commonly used in homogeneous and near homogeneous media, is generalized to inhomogeneous media governed by a nonlocal conductivity tensor. The expression for wave energy applies to linear excitations in an arbitrary three-dimensional equilibrium, while the expression for angular momentum applies to linear excitations of azimuthally symmetric equilibria. The wave energy is interpreted as the energy transferred from linear external sources to the plasma if there is no dissipation. With dissipation, such a simple interpretation is lacking as energy is also thermally absorbed. However, for azimuthally symmetric equilibria the expression for the wave energy in a frame rotating with a frequency ω, E/sub wave/ - ωL/sub wave//l where L/sub wave/ is the wave angular momentum defined in the text and l the azimuthal wavenumber, can be unambiguously separated from thermal energy, and is closely related the real part of a dispersion relation for marginal stability. The imaginary part of the dispersion is closely related to the energy input into a system. Another useful quantity discussed is the impedance form, which can be used for three-dimensional equilibrium without an ignorable coordinate and the expression is closely related to the wave impedance used in antenna theory. Applications to stability theory is also discussed. 19 refs.

6875 **(ENEA-RT-FUS—85-20) High resolution 14 MeV neutron spectrometer.** Pillon, M. (ENEA, Frascati, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700755/JAW.

A neutron spectrometer, based both on the track position identification and the energy measurement of recoiling protons from a hydrogenous radiator is proposed. The expected performance limits of this spectrometer with regard to energy resolution (deltaE/E), efficiency (epsilon) and counting rate are evaluated in five different configurations. The results show the possibility of deriving an optimized spectrometer design for applications on large fusion devices such as JET and NET with an energy resolution up 1% at 14 MeV.

6876 **(ENEA-RT-FUS—86-15) Canonical perturbation method for computing the guiding-center motion in magnetized axisymmetric plasma columns. Hamiltonian formulation of the equations.** Gratreau, P. (ENEA, Frascati, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700756/JAW.

The motion of charged particles in a magnetized plasma column, such as that of a magnetic mirror trap or a tokamak, is determined in the framework of the canonical perturbation theory through a method of variation of constants which preserves the energy conservation and the symmetry invariance. The choice of a frame of coordinates close to that of the magnetic coordinates allows a relatively precise determination of the guiding-center motion with a low-ordered approximation in the adiabatic parameter. A Hamiltonian formulation of the motion equations is obtained.

6877 (INIS-BR—897, pp 108) **Microwave scattering from Tokamak plasma.** Biswas, S.; Dasgupta, B.; Basu, J. (Saha Inst. of Nuclear Physics, Calcutta, India). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-8708185—).

From Energy independence conference: fusion energy and plasma physics; Rio de Janeiro, RJ, Brazil (17 Aug 1987).

6878 **(INIS-mf—10734) Institute for Plasma Research, Stuttgart University. Annual report 1986.** (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750549/JAW.

In 1986 the IPP-IPF cooperation in the field of fusion related research and development has been successfully continued. The ECRH project as the largest activity is concentrated on the completion of the 1 MW/70 GHz long-pulse ECRH-system for the W VII-AS stellarator. The components tests promise optimum technical and - hopefully - physical results. Theoretical investigations mainly concern ray propagation and time dependent transport calculations for stellarators at ECRH conditions. A first successful experimental demonstration of the LIDAR scattering concept on JET was a rather encouraging progress for the laser diagnostic group. Besides this project the FIR scattering was continued on ASDEX with measurements of the k-spectra of the low frequency fluctuations during the various kinds of plasma heating. On the WEGA stellarator a programme of flux surface measurements with electron beams has been started. A meanwhile improved detection method will be applied - in cooperation with the Wendelstein team - at the coming W VII-AS stellarator. In the last year the plasma focus experiment POSEIDON achieved successful operation at full bank energy.

6879 **(INIS-mf—10739) IPP (Max-Planck-Institute for Plasma Physics) annual report 1986.** (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). 1986. 197p. (In English). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751013/JAW.

The scientific activities of IPP comprise two programmes, tokamaks and stellarators, the main results of which are summarized in two overviews introducing the corresponding sections in the body of the report. The scientific work is firmly integrated into a network of cooperation. In Germany, we collaborate with the Nuclear Research Center Karlsruhe in the 'Entwicklungsgemeinschaft Kernfusion'; of the collaboration with universities the most successful has been that with Stuttgart on ECRH. The IPP programme forms an integral part of the European fusion programme.

6880 **(INIS-mf—11040) Wills Plasma Physics Department annual progress report 1986.** (Sydney Univ. (Australia). Dept. of Plasma Physics). 1987. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700664/JAW.

The experimental research program continues to have two major themes - the study of hydromagnetic waves and RF heating using the TORTUS tokamak and the development of diagnostic techniques. Gas discharge studies now include work on the characteristics of metal vapour vacuum arcs. Other areas include a study of the characteristics of the magnetron sputtering discharge used in the production of selective surfaces for solar collectors.

6881 **(IPF—87-4) On the course of fusion processes occurring in the plasma focus - an investigation by using time-resolved neutron spectroscopy.** Schmidt, R. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jan 1987. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751028/JAW.

The plasma focus POSEIDON emits up to 2x10/sup 11/ neutrons during some 100 ns, if it is operated with deuterium. This very high neutron production cannot be explained by a thermal neutron production mechanism starting out from the measured values of temperature (about 1 KeV) and deuteron density (10/sup 18/ cm/sup -3/). There is no doubt, that there exist strong "beam-target"-processes of the deuterons, which cause such a high suprathermal neutron production. The neutron emission of the plasma focus POSEIDON appears in two pulses, which are associated to the two main phases of the hot and dense plasma. The first is the pinch or quiescent phase, in which a stable plasma column over 100 or 150 ns exists. The second phase is characterized by turbulence processes and starts with the end of the stable phase with the on-set of the m=0-instabilities and ends with the decay of the plasma. Both phases of neutron production are studied by time-resolved analysis of the neutron anisotropy factor and by time and spatial-resolved measurements of the neutron emission. Hence it follows, that there exist during both phases different non thermal neutron production processes, which are caused by different deuteron acceleration mechanisms. To get information on these deuteron acceleration mechanisms it is appropriate to analyse the neutron spectra of the plasma focus, because the half-width and the shape of the measured spectra are related to the energy and the angular distribution of the accelerated deuterons.

6882 **(IPP—III/121) Periodic multichannel Thomson scattering in ASDEX.** Roehr, H.; Steuer, K.H.; Murmann, H.; Meisel, D. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jun 1987. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750547/JAW.

The optical and electronical setup of the Thomson scattering experiment in the ASDEX-Tokamak is described. This Thomson scattering system is employed as a standard diagnostic for the evaluation of electron temperature and density simultaneously at 16 spatial points in ASDEX. The light source is a Nd-YAG laser emitting at 1.06 μm wavelength, which is capable to deliver 60 pulses per second for a period of about 7 sec. This period includes the whole ASDEX plasma discharge. The scattered light is detected by Si-avalanche diodes. Density calibration is carried out by rotational anti-Stokes Raman scattering from molecular hydrogen. The system is capable of measuring densities as low as 5 x 10/sup 12/ cm/sup -3/ and electron temperatures in the range from 150 eV to 5 keV. The data-processing system and the calculations which lead to the final output of Te/Ne-profiles are discussed. Examples of profile measurements are given showing the possibilities of the system under various plasma conditions. Technical details of the system are described in tables listed in the appendix.

6883 **(ITEF—105(1986)) Self-similar solutions of MHD equations of plasma filament in the case of complete degenerated ultrarelativistic electron gas.** Sukhorukov, S.T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700684/JAW.

The self-similar solution of one-liquid MHD equations of perfectly conducting plasma filament describing adiabatic nonlinear pulsations of the plasma filament with current in case of complete degenerated ultrarelativistic electron gas has been found. 9 refs.; 1 fig.

6884 **(KFTI—86-29) Relativistic plasma concentration measuring by bremsstrahlung.** Gorozhanin, D.V.; Ivanov, B.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1986. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700560/JAW.

A method for measuring electron concentration (n/sub e/) in high-temperature plasma and in relativistic electron beams (REB) by integral electron bremsstrahlung on ions (neutrals) is suggested. Bremsstrahlung was measured by means of a scintillator from the volume filled with relativistic plasma generated in a mirror trap with an increasing magnetic field and representing rotating relativistic electrons charge-compensated by ions. A theoretical expression for effective bremsstrahlung cross section weakly depending on electron energy in the 10/sup 5/-10/sup 6/ eV range was used to determine n/sub e/. The results of measuring n/sub e/ agree with data of other papers, where other methods have been applied for this purpose. The given method may be applied in facilities with the use of REB for controlled fusion as well as in "Astron" and "Bampi torus" type facilities and others. 4 refs.; 2 figs.

6885 **(KFTI—87-2) Possibility of calculation of magnetic surface function gradient and related quantities.** Nemov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700561/JAW.

A calculation method for gradient of magnetic surface functions nablaPSI based on the solution of the standard linear differential equation system with variable coefficients is considered. The system described the behaviour of space derivatives of magnetic surface functions along the magnetic line of force. Computer-aided design of nablaPSI in torsatron magnetic fields as well as the examples of application of calculational results of nablaPSI when calculating the standard to the magnetic surface component of drift rate of charged particles and equilibrium currents in the plasma with low gas-kinetic pressure are given. 6 refs.; 4 figs.

6886 **(KFTI—87-8) Features of passage of charged particles through separatrix.** Buts, V.A.; Tolstoluzhskij, A.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700567/JAW.

Investigation of passage of a charged particle through the stochastic layer formed by the splitting separatrix separating the captured particles from flight ones is carried out taking the motion of the simple peudulum with damping under the action of external periodical perturbation. It is shown that, in case when the separatrix is splitted and the stochastic layer is formed, both the capture and reflection of particles by this layer are possible. 6 refs.; 2 figs.

6887 **(KFTI—87-12) Multiplication of runaway electrons.** Kuznetsov, Yu.K.; Lebed', S.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700738/JAW.

For the case of homogeneous fully-ionized plasma in a weak electric field a model is developed and collision integral is derived, which describe the "multiplication" effect of fast electrons as a result of near collisions of accelerated and thermal electrons. On the basis of kinetic equation solution for electron distribution function in momentum region criterion and condition for a strong "multiplication" effect of runaway electrons are determined. Peculiar-

ities of the "multiplication" effect in a toroidal discharge are studied. 24 refs.; 2 figs.

6888 **(N—87-28418) Role of plasma wave turbulence in the formation of shock waves in collisionless plasmas. Final report.** Mellott, M.M. (Iowa Univ., Iowa City (USA)). Sep 1987. 10p. (NASA-CR—181218; NAS—1.26:181218). NTIS, PC A02/MF A01.

A data set containing measurements for approximately 100 shock crossings was compiled, and plasma wave profiles were plotted in conjunction with magnetic field data. Three emissions analyzed include upstream electron plasma oscillations, ion acoustic noise, and low frequency electromagnetic noise. The data demonstrate that the observed waves are consistent with generation by the kinetic cross-field streaming instability. Reanalysis of shock overshoots prompted by the presence of plasma feet upstream of nominally subcritical shocks leads to the conclusion that no firm evidence exists for a sharp subcritical supercritical transition. Electron plasma oscillations persist up to the ramps of subcritical shocks and begin decaying at the front edge of the feet of supercritical shocks. Their intensity is anticorrelated with the amplitude of the foot ion acoustic noise. Wave measurements support the predicted predominance of lower hybrid-like modes over ion acoustic noise in the production of resistive (plasma) heating. Evidence for variable shock normal angles is seen upstream from nominally quasiparallel shocks. The first cases of very strong electron heating observed at the terrestrial bow shock were discovered.

6889 **(N—87-28423) Ground-based plasma contactor characterization.** Patterson, M.J.; Aadland, R.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 17p. (NASA-TM—100194; E—3784; NAS—1.15:100194; CONF-8710207—). NTIS, PC A02/MF A01.

From 2. international conference on tethers in space; Venice, Italy (6 Oct 1987).

Presented are recent NASA Lewis Research Center (LeRC) plasma contractor experimental results, as well as a description of the plasma contractor test facility. The operation of a 24 cm diameter plasma source with hollow cathode was investigated in the lighted-mode regime of electron current collection from 0.1 to 7.0 A. These results are compared to those obtained with a 12 cm plasma source. Full two-dimensional plasma potential profiles were constructed from emissive probe traces of the contractor plume. The experimentally measured dimensions of the plume sheaths were then compared to those theoretically predicted using a model of a spherical double sheath. Results are consistent for currents up to approximately 1.0 A. For currents above 1.0 A, substantial deviations from theory occur. These deviations are due to sheath asphericity, and possibly volume ionization in the double-sheath region.

6890 **(SFTI—4) Decay instabilities of cylindrical MHD waves in a collisionless magnetized plasma.** Grishanov, N.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi. Fiziko-Tekhnicheskij Inst.). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700574/JAW.

Parametric instabilities with regard to spatial cylindrical MHD oscillations in the presence of a pump Alfven wave in a plasma are considered with the help of the homogeneous plasma filament model in the kinetic approximation. The increments of these instabilities can be compared in magnitude with those of planes waves. The characteristic property is excitation of a wide spectrum of Alfven and slow magnetosonic waves for radial wave numbers. This phenomenon is due to the fact that the momentum conservation law for the cylindrical waves involved in the decay is realized approximately. Since the absorption mechanism for the waves under consideration is Landau collisionless damping on electrons, they can contribute to heating of the plasma electron component, especially at the initial stage, when ions are still cold. 7 refs.; 1 tab.

6891 **(UCRL—96721) Plasma parameters for alternate operating modes of TIBER-II.** Fenstermacher, M.E.; Devoto, R.S.; Logan, B.G.; Perkins, L.J. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—45). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001890/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Parameters for operating points of TIBER-II, different from the baseline steady-state operation, are presented. These results have been generated with the MUMAK tokamak power balance code. Pulsed ignited and high performance steady-state operating points are described. 20 refs.

6892 **(UCRL—96815) TIBER engineering test reactor (ETR) startup scenarios.** Blackfield, D.T.; Perkins, L.J. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—47). NTIS, PC A02. Order Number DE88001563/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A time-dependent Tokamak Systems Code (TTSC) has been developed and used to examine various inductively driven startup scenarios for the TIBER reactor. Radially averaged particle and energy balance equations are solved. In addition, time varying currents in the PF and OH coils are determined from MHD equilibrium and volt-seconds considerations. Less than 20 MW of auxiliary power deposited in the electrons is required to obtain steady-state operations. For this scenario, less than 10% of the total volt-seconds capability is consumed during startup and the currents in the PF and OH coils do not appear to exceed stress limits. For every volt-second saved during startup, the burn time can be extended 14 seconds. 4 refs., 6 figs., 3 tabs.

6893 **(UCRL—97585) TIBER II [Tokamak Ignition/Burn Experimental Reactor] parameters with neutral beams at high energies.** Devoto, R.S.; Fenstermacher, M.E.; Papanikolaou, P.G. (Lawrence Livermore National Lab., CA (USA); Purdue Univ., Lafayette, IN (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—44). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001891/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The baseline neutral beam energy for TIBER II was chosen to be 500 keV consistent with the use of near term dc acceleration technology. Adequate penetration to the axis for core current drive in larger ETR devices requires higher beam energies. However, beam instabilities may limit the current drive efficiency at high energy to lower values than predicted classically. The characteristics of TIBER II and a device with 4.5 m major radius as functions of beam energy are presented. 11 refs.

6894 **Steady-state tokamak discharge via dc helicity injection.** Ono, M.; Greene, G.J.; Darrow, D.; Forest, C.; Park, H.; Stix, T.H. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **59**: No. 19, 2165-2168(9 Nov 1987). Contract AC02-76CH03073.

A tokamak discharge has been formed and maintained through helicity injection, by use of only an external dc low-energy electron beam. The discharge, in a 5-kG toroidal field, evolved to a steady-state circular cross section with $q(a) = 10$, $q(0) = 4$, which was maintained for more than 400 L/R periods, the time (60 msec) limited by the cathode bias supply. The density profile reached a line-averaged n-bar/sub e/ = 2 x 10/sup 13/ cm/sup -3/, while T/sub e/ = 25 eV and T/sub i/ = 15 eV. Strong central peaking occurs and inward pinching is indicated for both density and current.

6895 **Laser-induced current switching observed in the discharge media of CF/sub 2/Cl/sub 2/-N/sub 2/ and CH/sub 3/Cl-N/sub 2/.** Wang, W.C.; Lee, L.C. (Dept. of Electrical and Computer Engineering, San Diego State Univ., San Diego, CA 92182). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 460-466(Aug 1987).

Switchings of discharge current induced by ArF and KrF laser pulses in the discharge media of CF/sub 2/Cl/sub 2/-N/sub 2/ and CH/sub 3/Cl-N/sub 2/ were investigated using a negative point-to-plane discharge apparatus. The electron attachment rate constants of CF/sub 2/Cl/sub 2/ in buffer gases of N/sub 2/ and Ar were measured by a parallel-plate drift-tube apparatus at various E/N, from which the dominant negative ions in the discharge media were inferred. The conductivity of the discharge medium is enhanced upon laser irradiation due to conduction electrons being produced from photoelectron-detachment of Cl/sup -/. From the dependence of the enhancement current on laser power, the photodetachment cross sections of Cl/sup -/ in a given discharge condition were derived to be 2.5 x 10/sup -17/ cm/sup 2/ at 193 nm and 1.0 x 10/sup -17/ cm/sup 2/ at 248 nm. After the current enhancement, the current was greatly reduced as was observed in the discharge medium of CF/sub 2/Cl/sub 2/-N/sub 2/, but not in CH/sub 3/Cl-N/sub 2/. The mechanism for the optically induced reduction of discharge current is discussed.

6896 **The current-voltage characteristics and potential oscillations of a double layer in a triple-plasma device.** Carpenter, R.T.; Torven, S. (Dept. of Physics and Astronomy, Univ. of Iowa, Iowa City, IA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 434-444(Aug 1987).

The properties of a strong double layer in a current circuit with a capacitance and an inductance are investigated in a triple-plasma device. The double layer gives rise to a region of negative differential resistance in the current-voltage characteristic of the device, and this gives nonlinear oscillations in the current and the potential drop over the double layer (PHI/sub DL/). For a sufficiently large circuit inductance PHI/sub DL/ reaches an amplitude given by the induced voltage (-Ldl/dt) which is much larger than the circuit EMF due to the rapid current decrease when PHI/sub DL/ increases. A variable potential minimum exists in the plasma on the low-potential side of the double layer, and the depth of the minimum increases when PHI/sub DL/ increases. An increasing fraction of the electrons incident at the double layer are then reflected, and this is found to be the main process giving rise to the negative differential resistance. A qualitative model for the variation of the minimum potential with PHI/sub DL/ is also proposed. It is based on the condition that the minimum potential must adjust itself self-consistently so that quasi-neutrality is maintained in the plasma region where the minimum is assumed.

6897 **On mixing length theory and saturated turbulence.** Diamond, P.H.; Carreras, B.A. (Texas Univ., Austin, USA. Inst. for Fusion Studies; Oak Ridge National Lab., TN, USA). *Comments on Plasma Physics and Controlled Fusion;* **10**: No. 6, 271-278(Mar 1987). Contract AC05-84OR21400;FG05-80ET53088.

Conventional methods for estimating turbulent transport are discussed in the light of recent investigations. Some of the pitfalls inherent in such methods are identified, and possible means for improvement are suggested.

6898 **Solid density, low temperature plasma formation in a capillary discharge.** Kania, D.R.; Jones, L.A.; Maestas, M.D.; Shepherd, R.L. (Physics Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 483-494 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

This work discusses the ability of the authors to produce solid density, low temperature plasmas in polyurethane capillary discharges. The initial capillary diameter is 20 μm. The plasma is produced by discharging a one Ohm parallel plate waterline and Marx generator system through the capillary. A peak current of 340 kA in 300 ns heats the inner wall of the capillary, and the plasma expands into the surrounding material. The authors studied the evolution of the discharge using current and voltage probes, axial and radial streak photography, axial x-ray diode array and schlieren photography, and have estimated the peak temperature of the discharge to be approximately 10 eV and the density to be near 10/sup 23/cm/sup -3/. This indicates that the plasma may approach the strongly coupled regime. They discuss their interpretation of the data and compare their results with theoretical models of the plasma dynamics.

6899 **The inverse bremsstrahlung absorption coefficient in strongly coupled plasmas.** Cauble, R.; Rozmus, W.; Davis, J. (Berkeley Research Associates, Springfield, VA 22151). pp 3-14 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The calculation of the inverse bremsstrahlung coefficient, which describes the absorption of laser light in plasma, reduces classically to a derivation of the frequency dependent electron-ion collision frequency, $\nu(\omega)$. In laser-plasma interactions at densities and temperatures typical of discussion at this conference, the usual Dawson-Oberman formulation of the collision frequency can be very much in error, since $\nu(\omega)$ in that case depends on the use of binary collisions and the concomitant assumption of weak particle correlations. A prescription of $\nu(\omega)$ has been constructed from classical kinetic theory using a semiclassical two-particle interaction thought to be valid when the plasma is moderately to strongly coupled. The prescription calls for static interparticle correlations functions which are supplied by the solution to the hypernetted chain (HNC) equations utilizing the semiclassical potential. These results are contrasted with the Dawson-Oberman result and results using employing Debye-Huckel correlations. Since the latter provide simple analytic forms for $\nu(\omega)$, the authors compare these results with those from HNC in hydrogen when the plasma coupling parameter Γ is $\leqq 1$.

6900 **Electrical conductivity of dense plasmas at temperatures of .5 to 1.0 eV.** Daniels, S.W.; Griem, H.R.; Krumbein, A.D. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD 20742). pp 389-402 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The electrical conductivity of a plasma containing a mixture of light elements at densities near 1 g/cm/sup 3/ is studied at temperatures from 0.5 to 1 eV. This regime, encountered in chemical explosives, has received little attention because it is at the lower bound of interest for plasma physics and the upper bound of interest for chemistry. The dissociation equilibria of molecules are treated using Vardya's model for pressure dissociation. The Saha equation is used to form a system of equations which is solved numerically to determine the equilibrium populations. Effects which are considered include the existence of negative ions, reduction of ionization potentials in a plasma, and pressure ionization. It is found that H/sup -/ can be a primary negative carrier. The electrical conductivity is then calculated using an approximate electron-atom cross section. The results for hydrogen are compared with a number of published measurements and calculations.

6901 **X-ray spectroscopy and determining plasma dynamics.** Kauffman, R.L.; Estabrook, K.G.; Lee, R.W. pp 128-135 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

An application of plasma x-ray spectroscopy to determine plasma parameters is briefly discussed. An experimental design that takes some of the uncertainty away from the analysis is described and the results are briefly outlined.

6902 **Non-thermal effects in a hot dense plasma.** Jones, L.A. (Los Alamos National Lab., Los Alamos, NM). pp 107-127 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

Observations made on collapsing gas shell Z-pinches have produced some results which are difficult to explain by using the usual thermal model. These pinches produce a fast burst of x-rays at the time of pinch usually by exciting the closed shell resonance lines, i.e. He-, Ne-, or Ar- like emission. This emission comes from so called "hot spots" which form at irregular intervals along the pinched column axis. These "hot spots" are peculiar in that their diameter is always smaller than the smallest diameter observed for the pinching plasma column. This paper briefly describes a hollow gas shell Z-pinch device and shows how some initial observation lead to the conclusion that there is an energetic electron beam produced along the axis of the collapsing gas shell. The author summarizes an experiment that directly measured some of the characteristics of this runaway electron beam. The results of an experiment which observed a new effect are presented along with a model that uses a runaway electron beam to explain this new effect.

6903 **A time-dependent ionization balance model for non-LTE plasma.** Lee, Y.T.; Zimmerman, G.B.; Bailey, D.S.; Dickson, D.; Kim, D. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp 495-533 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—). Contract W-7405-ENG-48.

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The authors developed a detailed configuration accounting kinetic model which is useful for calculating time-dependent ionization balance and ion level populations in non-LTE plasmas. The model is also self-consistently coupled to the hydrodynamic code LASNEX to design laboratory x-ray laser experiments. Level populations estimated using the model are used to compute spectral line intensities, line ratios, and synthetic spectra to fit experimental measurement.

6904 **Theory of thermal solitary vortices in current-carrying edge plasmas.** Mondt, J.P.; Liu, J. (Los Alamos National Lab., NM, USA; Texas Univ., Austin, USA. Dept. of Physics). *Journal of Plasma Physics;* **36**: 235-242(Oct 1986).

It is shown that the nonlinear dynamics of current-convective excitations in current-carrying edge plasmas allows for the existence of solitary vortices despite the effects of magnetic shear and dissipation in the form of parallel electron thermal conductivity. The potential importance of this finding with regard to heat balance is pointed out.

6905 **Low-frequency waves in a high-beta collisionless plasma: polarization, compressibility and helicity.** Gary, S.P. (Los Alamos National Lab., NM, USA). *Journal of Plasma Physics;* **35**: 431-447(Jun 1986).

The linear theory of waves near and below the ion cyclotron frequency in an isothermal electron-ion Vlasov plasma which is isotropic, homogeneous and magnetized is considered. Numerical solutions of the full dispersion equation for the magnetosonic whistler and Alfven/ion cyclotron modes at βsub(i)=1.0 are presented, and the polarizations, compressibilities, helicities, ion Alfven ratios and ion cross-helicities are exhibited and compared. At sufficiently large βsub(i) and theta , the angle of propagation with respect to the magnetic field, the real part of the polarization of the Alfven/ion cyclotron wave changes sign, so that, for such parameters, this mode is no longer left-hand polarized. The Alfven/ion cyclotron mode becomes more compressive as the wavenumber increases, whereas the magnetosonic/whistler becomes more compressive with increasing theta. At oblique propagation, the helicity of both modes approaches zero in the long-wavelength limit; in contrast, the ion cross-helicity is of order unity for the Alfven/ion cyclotron wave and decreases as theta increases for the magnetosonic/whistler mode.

6906 **Coherent magnetic perturbations in S-1 Spheromak plasmas.** Janos, A.; Hart, G.; Nam, C.H.; Yamada, M. (Princeton Univ.). pp 2P-11 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

Toroidally coherent modes have been observed in the S-1 Spheromak plasma by analysis of magnetic field perturbations measured from outside the plasma. The modes are of low n number, where n is defined by the functional dependence e/sup i(nphi+mθ)/ of the perturbation on toroidal angle phi and poloidal angle θ. These modes are shown to be associated with flux conversion and plasma relaxation during the spheromak formation. The modes are active while the q profile is rapidly changing, with q on axis, q/sub o/, rising to 0.7. A significant finding is the temporal progression through the m = 1; n = 5, 4, 3, 2 mode sequence as q rises through rational fractions m/n. Peak amplitudes of the n = 2, 3, 4 modes relative to the unperturbed field have been observed as high as 20%, while more typical amplitudes are below 5%. Locally coherent modes of high-n number are also observed. The improved understanding of the spheromak flux conversion mechanism greatly improves the prospects for making high-powered spheromak fusion devices.

6907 **Enhancement of gain in neon-like ions by pumping with a quasi-resonant high energy electron tail.** Apruzese, J.P.; Davis, J. (Plasma Radiation Branch, Code 4720, Naval Research Lab., Washington, DC 20375). pp 221-240 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

The authors demonstrate quantitatively that suprathermal electrons such as those produced in high power laser-plasma experiments may be used to substantially enhance gain in 3p-3s transitions of neon-like ions. Specific calculations were performed using a detailed model of ionized iron. The energy of the suprathermals must be roughly matched to the threshold excitation energy of the (upper) 3p lasing state. For iron, this energy is — 800eV and necessitates the use of very low irradiances to achieve gain at 255A. Using approximate scaling laws, the possibility of utilizing the technique with higher atomic number elements to achieve gain at shorter wavelengths is assessed. It is found that this method is probably viable for atomic numbers as high as Z=50 (tin), where lasing would occur at 118A. Recombination losses, however, render plasmas with the required properties above Z — 60 difficult to sustain with currently available laser powers.

6908 **Spectroscopic diagnostics of laser driven implosions.** Delamater, N.D.; Hooper, C.F. Jr.; Joyce, R.F.; Woltz, L.A.; Kauffman, R.L.; Lee, R.W. (Univ. of Florida, Gainesville, FL 32611). pp 302-314 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Glass microballons filled with mixtures of Ar/Ne imploded using the Omega laser system at the University of Rochester Labo-

ratory for Laser Energetics. Experimentally observed X-ray spectral lines were analyzed to determine plasma core parameters and to study the effects of capacity on spectroscopic diagnostics. A method previously introduced was employed to determine values of electron and ion densities self-consistently for all observed Lynam series lines in each shot using Stark and opacity broadened line profiles. The prominent Helium-like satellite lines situated on the red wing of the Hydrogen-like Lyman alpha line were observed as an additional diagnostic of electron density and the results compared with those of the line-broadening analysis. The observed line profiles were fitted to theoretical Stark and Doppler broadened profiles which were further broadened by the effects of opacity and a gaussian instrumental width. The opacity formula employed in the author's analysis is that appropriate for the normally emergent intensity from a uniformly emitting and absorbing slab.

6909 **Line intensities for diagnosing laser-produced plasmas.** Kauffman, R.L.; Matthews, D.L.; Lee, R.W.; Whitten, B.L.; Kilkenny, J.D. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 281-301 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

The authors have measured relative line intensities of the K x-ray spectra of Si, Cl, and Ca from laser-produced plasmas to assess their usefulness as a plasma diagnostic. The different elements are added at low concentrations to CH disks which are irradiated at 5 x 10/sup 14/ W/cm/sup 2/ with a 0.53 μm laser pulse of 20 Joules at 1 nsec. The concentration of each element is kept low in order not to change the Z of the plasma, and therefore the plasma dynamics. The various spectra are measured with a time-resolved spectrograph to obtain line intensities as a function of time over the length of the laser pulse. These relative intensities of various He-like and H-like lines are compared with calculations from a steady-state level population code. The results give good consistency among the various line ratios. Agreement is not as good for analysis of the Li-like satellite lines. Modelling of the Li-like lines need further investigation.

6910 **Modeling the spectroscopy for partially filled L- and M-shells in hot plasmas.** Goldberg, A.; Rozsnyai, B.F. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 423-450 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—). Contract W-7405-ENG-48.

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

The authors present an algorithm suitable for the accounting of the large number of spectral lines in a partially ionized plasma. The method combines the principles of the "average atom" with those of the detailed spectroscopic accounting. The necessary equation-of-state quantities, such as degrees of ionization, occupation of single electron states, Fermi level, degree of fluctuations, etc., are determined from a self-consistent average atom model. From the above, the most relevant spectroscopic states can be determined for the most probable ionization states. Since the computation problem can be enormous, approximations are a practical necessity. Presently, they use first order perturbation theory for the computation of spectroscopic terms in the LS coupling scheme. They discuss the model with the other approximations and present some computed data for iron plasma at temperatures and densities when partially filled L and M shells occur.

6911 **Proceedings of the 2nd international conference on radioactive properties of hot dense matter.** Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). 609p. (CONF-8310178—). World Scientific Pub. Co., 687 Hartwell Street, Teaneck, NJ 07666.

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

These proceedings contain discussions on the radiative properties of hot dense matter, including radiative transfer and opacity; atomic processes in dense plasma; plasma spectroscopy; and equations of state and microfields.

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REFER ALSO TO CITATION(S) 6301, 6869, 6878, 6879, 6908

6912 **(CONF-861110—4-Vugraphs) Poloidal magnetics of compact ignition tokamaks.** Strickler, D.J.; Peng, Y.K.M.; Galambos, J.D. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001774/JAW.

From American Physical Society Plasma Physics Division meeting; Baltimore, MD, USA (3 Nov 1986).

The present compact ignition tokamak (CIT) design point (R = 1.225 m, a = 0.454 m, B = 10.4 T, I = 10 MA) is optimized with respect to device size for limiter operation. The CIT poloidal field (PF) system is designed for both limiter and divertor (at I = 9 MA) scenarios. Forming a poloidal separatrix within the limiter vacuum chamber requires a divertor plasma elongation $\kappa = 2.0$ and almost twice the PF energy as the limiter case. This study examines the dependence of PF system characteristics on the plasma elongation within the context of design points optimized for divertor operation. It is shown that higher elongation $\kappa = 2.0$ considerably simplifies the CIT poloidal magnetic systems subject to device design constraints.

6913 **(CONF-871007—33) Brazing of ceramic and graphite to metal in the fabrication of ICRF [ion cyclotron range of frequencies] antenna and feedthrough components.** Schechter, D.E.; Sluss, F.; Hoffman, D.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE88001763/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Fabrication of some of the more critical components of ion cyclotron range of frequencies (ICRF) antenna and feedthrough assemblies has involved the brazing of alumina ceramic and graphite to various metals. Copper end pieces have been successfully brazed to alumina cylinders for use in feedthroughs for TEXTOR and in feedthroughs and capacitors for a Tokamak Fusion Test Reactor (TFTR) antenna. Copper-plated Inconel rods and tubes have been armored with graphite for construction of Faraday shields on antennas for Doublet III-D and TFTR. Details of brazing procedures and test results, including rf performance, mechanical strength, and thermal capabilities, are presented. 14 figs.

6914 **(CONF-871210—2) ATF [Advanced Toroidal Facility] ECH [Electron Cyclotron Heating] waveguide component development and testing.** Bigelow, T.S.; White, T.L.; Kimrey, H.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 2p. NTIS, PC A02. Order Number DE88001432/JAW.

From 12. annual international conference of the Institute of Electrical and Electronics Engineers on infrared and millimeter waves; Orlando, FL, USA (14 Dec 1987).

The Advanced Toroidal Facility (ATF) Electron Cyclotron Heating (ECH) system presently under construction will consist of two 53.2-GHz, 200-kW continuous-wave (cw) gyrotrons with a mode-controlled waveguide system and polarized launcher optimized for maximum power in the ATF plasma. Several components, such as a waveguide mode-analyzing directional coupler, a TiO_2 mode absorber, miter bends, and a polarization-selectable beamed launcher, have been developed and tested. Laboratory results and initial high-power operation of the system are presented. 2 refs., 2 figs.

6915 **(CONF-8706184—4-Vugraphs) Systems code, cost scaling code, and systems analysis.** Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03. Order Number DE88001772/JAW.

From TIBER II review meeting; Oak Ridge, TN, USA (16 Jun 1987).

This paper contains viewgraphs of a comparative study on systems analysis, cost estimates, and reactor parameters of different types of tokamak reactors. (LSP)

6916 **(CONF-8707105—2) Physics rationale for the engineering specifications for ZTH.** Dimarco, J.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000938/JAW.

From International workshop on engineering design of next step reversed field pinch devices; Los Alamos, NM, USA (13 Jul 1987).

This report presents the physics rationale that established the engineering design of ZTH. The physics criteria are given and the implications regarding the engineering design are presented. Experimental and theoretical background evidence is given in support of the criteria but the justification is left to other reports and peer reviews. The physics criteria discussed here are limited to the ones deemed to be of highest engineering priority. 32 refs., 9 figs.

6917 **(CONF-8708138—2-Vugraphs) Overview of ORNL Program.** Rowcliffe, A.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001756/JAW.

From U.S./USSR fusion materials workshop; Oak Ridge, TN, USA (31 Aug 1987).

This paper consists of viewgraphs on the development of structural materials for first wall and blanket applications for both near-term and long-term thermonuclear fusion devices. (LSP)

6918 **(CONF-8708138—4-Vugraphs) Swelling behavior of ferritic/martensitic steels.** Maziasz, P.J.; Klueh, R.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001757/JAW.

From U.S./USSR fusion materials workshop; Oak Ridge, TN, USA (31 Aug 1987).

The 9Cr and 12Cr martensitic/ferritic steels are candidate first wall and blanket materials for application in magnetic fusion energy systems. This paper contains viewgraphs reviewing the attractive properties and the problems associated with using these steels as first wall materials. (LSP)

6919 **(CONF-8708138—5-Vugraphs) Irradiation creep in the US fusion alloy PCA at fusion He/dpa levels.** Grossbeck, M.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001758/JAW.

From U.S./USSR fusion materials workshop; Oak Ridge, TN, USA (31 Aug 1987).

Irradiation creep has been studied in fast reactors where little helium is generated and in research reactors where very high levels of helium are generated in stainless steels. A summary of the conclusions made from the viewgraph information of this paper follows: the creep rate is 4 to 10 times higher for the fusion He/dpa ratio compared to the breeder reactor results; higher creep rate can only result from differences in the neutron spectrum; a higher level of irradiation creep could be beneficial in relieving swelling stresses, but detrimental in causing deformation under primary loads in the structure. (LSP)

6920 **(CONF-8708138—6-Vugraphs) Welding of helium-doped Type 316 stainless steel.** Lin, H.T.; Grossbeck, M.L.; Chin, B.A.; Goods, S.H. (Oak Ridge National Lab., TN (USA); Auburn Univ., AL (USA); Sandia National Labs., Livermore, CA (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02. Order Number DE88001730/JAW.

From U.S./USSR fusion materials workshop; Oak Ridge, TN, USA (31 Aug 1987).

The present experiment is designed to investigate the effect of helium on the mechanical properties of welds in Type 316 stainless steel. The report consists of viewgraphs.

6921 **(CONF-8708138—7-Vugraphs) Manganese-stabilized austenitic stainless steels for fusion applications.** Klueh, R.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001759/JAW.

From U.S./USSR fusion materials workshop; Oak Ridge, TN, USA (31 Aug 1987).

This paper consists of viewgraphs on the tensile properties of manganese-stabilized austenitic stainless steels under irradiation conditions of a fusion reactor. It is concluded that the swelling rate is less for this steel than EP-838 steel. (LSP)

6922 **(CONF-8709173—1-Vugraphs) Calculation of radial and vertical forces on the CIT 1.75 m vacuum vessel for several TSC disruption scenarios.** Sayer, R.O. (Oak Ridge National Lab., TN (USA)). 15 Sep 1987. Contract AC05-84OR21400. 35p. NTIS, PC A03. Order Number DE88001770/JAW.

From CIT PF design meeting; Princeton, NJ, USA (15 Sep 1987).

The report consists of viewgraphs. (WRF)

6923 **(CONF-8709173—2-Vugraphs) Poloidal magnetics studies on swept divertor and internal coil issues.** Strickler, D.J. (Oak Ridge National Lab., TN (USA)). 15 Sep 1987. Contract AC05-84OR21400. 27p. NTIS, PC A03. Order Number DE88001775/JAW.

From CIT PF design meeting; Princeton, NJ, USA (15 Sep 1987).

This paper consists of viewgraphs on swept divertors and internal magnet coils for a Compact Ignition Tokamak design. The author concludes that poloidal field energy and volt-second considerations suggest a swept divertor scenario where the outboard strike point moves from small R to large R, while the inboard strike point moves from small Z to large Z. (LSP)

6924 **(DOE/ER—0313/2) Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.** (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 298p. (ORNL/M—353). NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88001486/JAW.

This is the second in a series of semiannual technical progress reports on fusion reactor materials. This report combines research and development activities in the following areas: (1) Alloy Development for Irradiation Performance; (2) Damage Analysis and Fundamental Studies; and (3) Special Purpose Materials. These activities are concerned principally with the effects of the neutronic and chemical environment on the properties and performance of reactor materials; together they form one element of the overall materials program being conducted in support of the Magnetic Fusion Energy Program of the US Department of Energy. Separate analytics were prepared for the reports in this volume.

6925 (DOE/ER—0313/2, pp 3-4) **RTNS-II irradiations and operations.** Short, D.W.; Heikkinen, D.W. (Lawrence Livermore National Lab., CA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report lists experimenters and the materials they irradiated at the Rotating Target Neutron Source (RTNS-II) during the present reporting period. 1 tab. (JDH)

6926 (DOE/ER—0313/2, pp 4-8) **RTNS-II status.** Short, D.W.; Heikkinen, D.W. (Lawrence Livermore National Lab., CA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report presents operational information about the Rotating Target Neutron Source (RTNS). Data presented include neutrons produced by year, availability, productivity, and staff radiation doses. 4 figs. (JDH)

6927 (DOE/ER—0313/2, pp 8-9) **Design and fabrication of HFIR-MFE RB spectral tailoring irradiation capsules.** Longest, A.W.; Thoms, K.R.; Corum, J.E. (Oak Ridge National Lab., TN; Midwest Technical, Inc., Oak Ridge, TN). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This paper describes the design of irradiation capsules for use in experiments to be carried out at the HFIR reactor. The experiments are part of a fusion reactor materials testing program. 2 refs., (JDH)

6928 (DOE/ER—0313/2, pp 10-17) **The HFIR instrumented (JP type) target temperature test (TTT) capsule.** Siman-Tov, I.I. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report presents temperature measurements made on an irradiation capsule placed in the HFIR reactor. Temperature distributions are presented and an empirical relationship for heat generation is given. 6 refs., 6 figs., 1 tab. (JDH)

6929 (DOE/ER—0313/2, pp 18) **Operation of the US/Japan ORR spectral tailoring experiments.** Siman-Tov, I.I. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

6930 (DOE/ER—0313/2, pp 19-20) **Status of US/Japan collaborative testing in HFIR and ORR.** Scott, J.L.; Hamada, S. (Oak Ridge National Lab., TN; Japan Atomic Energy Research Institute). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

6931 (DOE/ER—0313/2, pp 21-22) **Fusion program research materials inventory.** Roche, T.K.; Davis, J.W. (Oak Ridge National Lab., TN; McDonnell Douglas Astronautics Co., St. Louis, MO). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report is a listing of materials available at ORNL for the Fusion Reactor Materials Program. Directions for ordering are provided. 1 tab. (JDH)

6932 (DOE/ER—0313/2, pp 25) **Neutronics analysis in support of the US/Japan spectral tailoring capsules.** Lillie, R.A. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

6933 (DOE/ER—0313/2, pp 26-30) **Cross section measurements for long-lived isotopes.** Greenwood, L.R.; Bowers, D.L. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report describes measurement of neutron production cross sections for nickel, iron, copper isotopes. Experimental results are presented. Interest in the above materials is due to their presence in fusion reactors. 11 refs., 2 figs., 2 tabs. (JDH)

6934 (DOE/ER—0313/2, pp 31-33) **Measurements for the JP2, JP6, JP7 US/Japanese experiments in HFIR.** Greenwood, L.R. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report presents experimental results for irradiation of stainless steel in the High Flux Isotope Reactor (HFIR). (JDH)

6935 (DOE/ER—0313/2, pp 34-37) **Dosimetry and damage analysis for the Omega West Reactor.** Greenwood, L.R. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report presents neutron flux measurements carried out at the Omega West Reactor. 3 refs., 2 figs., 4 tabs. (JDH)

6936 (DOE/ER—0313/2, pp 38-40) **Dosimetry and damage analysis for HFIR-CTR-47/48.** Greenwood, L.R. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report presents neutron flux measurements performed at the High Flux Isotope Reactor (HFIR). 4 refs., 4 tabs. (JDH)

6937 (DOE/ER—0313/2, pp 41-42) **Activation calculations.** Mann, F.M. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report briefly discusses calculations made to predict activation of elements in a fusion reactor. (JDH)

6938 (DOE/ER—0313/2, pp 47-50) **Analysis of the effect of internal hydrogen on the fatigue crack growth of HT-9.** Jones, R.H. (Pacific Northwest Lab., Richland, WA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report presents work carried out to investigate the effects of hydrogen on crack propagation in alloy HT-9. The fracture mechanics of this material is of interest due to its use in fusion reactors. 6 refs., 4 figs. (JDH)

6939 (DOE/ER—0313/2, pp 53-76) **The influence of both major and minor element composition on void swelling in simple austenitic steels.** Garner, F.A.; Kumar, A.S. (Hanford Engineering Development Lab., Richland, WA; Univ. of Missouri, Rolla). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Data on the neutron-induced swelling of simple Fe-Ni-Cr austenitic alloys are presented to show that there are three compositional regimes of swelling as a function of nickel content. Data are also presented to show the influence of silicon and phosphorus on the neutron-induced swelling of Fe-25Ni-15Cr and to demonstrate that the separate influence of each of these elements is more complex than previously observed. A model is presented to show that the major effect of composition on swelling lies in its influence on void nucleation, operating primarily on the intermediate transition regime. Compositional variations thus appear as a "temperature shift" analogous to that associated with changes in displacement rate. This shift is due to the effect of each element on the vacancy supersaturation via their effect on either the equilibrium vacancy concentration or the effective vacancy diffusion coefficient. 61 refs., 26 figs., 2 tabs.

6940 (DOE/ER—0313/2, pp 77-87) **The behavior of solute segregation and void formation in Fe-Cr-Ni and Fe-Cr-Mn steels during electron irradiation.** Takahashi, H.; Garner, F.A.; Itoh, H.; Ohnuki, S. (Hokkaido Univ., Sapporo, Japan; Hanford Engineering Development Lab., Richland, WA; Beijing Univ. of Iron and Steel Technology, China). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

The relative swelling behavior of Fe-Cr-Mn and Fe-Cr-Ni alloys during electron irradiation is shown to be different from that observed in neutron irradiations. This difference appears to a consequence of the different diffusion behavior of nickel and manganese in response to the operation of the inverse Kirkendall effect. The vacancy gradients driving the diffusion in these experiments are generated not only by the foil surfaces and the electron-generated radial displacement gradient but also by high angle grain boundaries deliberately centered in the middle of the electron beam. This procedure allows the relative diffusional characteristics of each element to be observed by EDX measurements across the grain boundary. The influence of helium and minor solutes on swelling was also studied in these experiments and yielded no behavior atypical of that observed in neutron irradiation studies. 22 refs., 9 figs., 1 tab.

6941 (DOE/ER—0313/2, pp 88-98) **The critical radius for void nucleation in neutron irradiated ferritic alloy.** Coghlan, W.A.; Gelles, D.S. (Arizona State Univ., Tempe; Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Experimental measurements of cavity formation in HT-9 following irradiation to 39 dpa at 300, 400, 500 and 600°C are used as a basis for examining the critical radius for void nucleation model as applied to ferritic alloys. Calculations demonstrate that the value for critical radius following irradiation at 400°C can be predicted, that values for critical radius at 500 and 600°C are in agreement with experiment but that values for critical radius at 300°C are below experimental values. Calculations are compared with those on a ferritic alloy following ion bombardment. Possible explanations are suggested. 14 refs., 10 figs., 1 tab.

6942 (DOE/ER—0313/2, pp 99-104) **Defect production and hardening in neutron-irradiated copper.** Zinkle, S.J. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

The fraction of Frenkel defects that survive in isolated or clustered form during room temperature irradiation of copper has been measured as a function of fluence by a combination of TEM and electrical resistivity methods. The ratio of surviving to created defects decreased from 12 to 4.7% as the fluence of 14-MeV neutrons increased from 1×10^{20} to 2.9×10^{21} n/m^2. A comparison of the TEM and resistivity data with radiation hardening studies indicates that the barrier strength of loops (β) may also depend on fluence, at least at low fluences. 23 refs., 2 figs., 4 tabs.

6943 (DOE/ER—0313/2, pp 105-109) **Computer simulation of ion beam mixing: Part 1.** Han, S.; Kulcinski, G.L. (Univ. of Wisconsin, Madison). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Ion beam mixing, which is defined as the application of energetic heavy ion beam to induce materials interactions in thin-film composite sample or pre-implanted solids, has been received a great concern by many research groups. However, the complicated nature of mixing process makes it hard to predict the dynamic behavior of the materials during ion beam irradiation. Monte Carlo methods have been used to solve this problem and in this study, the accuracy of such a program was tested to calculate the ion range before further modification of the program. 16 refs., 4 figs.

6944 (DOE/ER—0313/2, pp 115-118) **Charpy impact test results of ferritic alloys from the HFIR-MFE-RB2 test.** Hu, W.L.; Gelles, D.S. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Miniature Charpy specimens of HT-9 in base metal, weld metal and heat affected zone (HAZ) metal conditions, and 9Cr-1Mo in base metal and weld metal conditions have been tested following irradiation in HFIR-MFE-RB2 at 55°C to $\approx$10 dpa. All specimen conditions have degraded properties (both DBTT and USE) in comparison with specimens irradiated to lower dose. 9Cr-Mo degraded more than HT-9 and weld metal performed worse than base metal which performed worse than HAZ material. Property degradation was approximately linear as a function of dose, indicating that degradation response had not saturated by 10 dpa. 6 refs., 2 figs., 2 tabs.

6945 (DOE/ER—0313/2, pp 119-130) **Charpy impact test results for low activation ferritic alloys.** Cannon, N.S.; Hu, W.L.; Gelles, D.S. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Six low activation ferritic alloys have been tested following irradiation at 365°C to 10 dpa and compared with control specimens in order to assess the effect of irradiation on Charpy impact properties. It is found that alloys of composition Fe-2Cr-1.5V, Fe-12Cr-6Mn-1V and Fe-12Cr-6Mn-1W develop unacceptably large shifts in DBTT due to irradiation, Fe-9Cr-1V develops a small shift and Fe-9Cr-1W and Fe-7.5Cr-2W develop negligible shifts. There is little effect on USE in all cases. It appears that alloy development of low activation ferritic alloys should be concentrated in the Fe-7.5 to 9Cr range. 9 refs., 6 figs., 3 tabs.

6946 (DOE/ER—0313/2, pp 131-134) **Tempering effects on a 12 CR low activation steel.** Griffin, R.D.; Dodd, R.A.; Kulcinski, G.L. (Univ. of Wisconsin, Madison). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

A martensitic steel similar to HT-9 has been designed to reduce activation levels following irradiation. Hardness tests, optical metallography and transmission electron microscopy are being used to determine the response of the steel to tempering. 2 refs., 3 figs.

6947 (DOE/ER—0313/2, pp 135-150) **Properties of welded low activation ferritic alloys.** Lin, H.T.; Chin, B.A. (Auburn Univ., AL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Sound autogeneous welds can be produced readily in thin sheets of the low activation ferritic alloys patterned on 2-1/4 Cr-1Mo, 9 Cr-1 Mo and 12 Cr-1Mo steels. The as-welded 2-1/4 Cr and 9 Cr alloys show typical microstructures of banite and martensite respectively, while 12 Cr alloys show the duplex ferrite-martensite. Observations indicate that there is a tendency to form delta ferrite in both fusion and heat-affected zones if the concentration of vanadium is greater than 1 wt %. In addition, the strengthening effect caused by the addition of tungsten and tantalum is not significant. The mechanical results suggest that a post-weld heat treatment is recommended for both 9 Cr and 12 Cr low activation alloys to enhance impact properties. 2 refs., 11 figs., 2 tabs.

6948 (DOE/ER—0313/2, pp 151-161) **The development of ferritic steels for fast induced-radioactivity decay.** Klueh, R.L. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Induced radioactivity in the first-wall and blanket-structure materials will make these components highly radioactive after their service lifetime, leading to difficult radioactive waste-management problems. One way to minimize the disposal problem is to use structural materials in which radioactive isotopes induced by irradiation decay quickly to levels that allow simplified disposal techniques. We are assessing the feasibility of developing such ferritic steels. Tensile studies were made on eight heats of normalized-and-

tempered chromium-tungsten steel that contained various levels of chromium, tungsten, vanadium, and tantalum. The strength and ductility of these steels were found to compare favorably with the properties of analogous chromium-molybdenum steels that are presently being considered as candidate structural materials for fusion reactor applications. 7 refs., 8 figs., 1 tab.

6949 (DOE/ER—0313/2, pp 162-169) **Postirradiation tensile behavior of nickel-doped ferritic steels.** Klueh, R.L. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Tensile specimens of normalized-and-tempered 9Cr-1MoVNb, 9Cr-1MoVNb-2Ni, 12Cr-1MoVW, 12Cr-1MoVW-1Ni, and 12Cr-1MoVW-2Ni steels were irradiated in the HFIR at 300, 400, and 500°C to displacement-damage levels of up to ~11 dpa. The nickel was added to the ferritic steels to produce helium during irradiation in this mixed-spectrum reactor. Up to 103 appM He was produced in the steels with 2% Ni. Irradiation at 300 and 400°C caused an increase in strength of all the steels relative to the strength in both the normalized-and-tempered condition and after aging the normalized-and-tempered steel for a time period similar to that in the reactor. The strength increases were accompanied by a loss of ductility. At 500°C, there was little change in the strength properties of the steels. The results at 300 and 400°C indicate an effect of helium on the strength increases; no helium effect was apparent for the specimens irradiated at 500°C. 11 refs., 6 figs., 3 tabs.

6950 (DOE/ER—0313/2, pp 173-187) **The development of austenitic stainless steels for fast induced-radioactivity decay.** Klueh, R.L.; Maziasz, P.J. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

As part of an alloy-development program for a nickel-free stainless steel, five Fe-Mn, thirteen Fe-Cr-Mn, and fifteen Fe-Cr-Mn-C alloys were examined to determine the austenite-stable region in the Fe-Cr-Mn-C system. After various heat treatments, optical and electron microscopy studies and magnetic measurements were used to assess the microstructural constituents present. The results indicate that the Schaeffler diagram, which was developed to predict the phases present in Fe-Cr-Ni-C stainless steels, cannot be directly applied to Fe-Cr-Mn-C steels. Manganese has a lower austenite-stabilizing capability against δ-ferrite formation than the Schaeffler diagram predicts by simply considering it half as effective as nickel. However, its stabilizing capability against martensite formation is higher than predicted by the diagram on the same basis. The new results can be used to empirically establish the austenite-stable composition region that should be suitable for alloying to develop a manganese-stabilized stainless steel. 15 refs., 14 figs., 5 tabs.

6951 (DOE/ER—0313/2, pp 188-204) **Some effects of thermal-mechanical pretreatment and alloy compositional variation on swelling of austenitic stainless steels irradiated in HFIR.** Maziasz, P.J.; Scott, J.L.; Turner, L.J.; Hamada, S.; Tanaka, M.P. (Oak Ridge National Lab., TN; Japan Atomic Energy Research Institute). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

A precision densitometer has recently been installed at ORNL for remote measurement of immersion density of irradiated transmission electron microscopy (TEM) disks. Some disks have been measured from the HFIR-JP1 and -JP3 experiments, irradiated at 300 and 400°C, respectively, to 34 dpa, and nearly all the disks have been measured from HFIR-JP7 and -JP8, irradiated at 500°C to 34 and 57 dpa, respectively. Very little swelling was measured in any of the disks irradiated at 300 and 400°C, but swelling was variable, and in many cases quite large, at 500°C. Only a few alloys appear to be swelling resistant. Of the Japanese alloys, the JPCA was the best, particularly when irradiated in the 20% cold worked (CW) condition. Swelling of the USPCA in the 25% CW (B3) condition was less than the 20% CW JPCA after 57 dpa at 500°C. An unusual decrease in swelling occurred with increased dose from 34 to 57 dpa. The US alloys included many modifications of the PCA composition, but the most swelling-resistant alloys contained 0.03 to 0.07 wt % P. 26 refs., 13 figs., 5 tabs.

6952 (DOE/ER—0313/2, pp 205-212) **Irradiation-produced precipitates in austenitic stainless steels irradiated in HFIR to 36 dpa at 600°C.** Hamada, S.; Suzuki, M. (Oak Ridge National Lab., TN; Japan Atomic Energy Research Institute). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Four solution-annealed austenitic stainless steels (JPCA, low-carbon stainless steel with titanium and niobium, and J316) were irradiated in HFIR to 36 dpa. In JPCA, swelling was very low (0.2%) and the only phase present was MC uniformly distributed in the matrix. On the other hand, the other three alloys indicated a large amount of swelling (>1%), and coarse precipitates, (mainly G, Laves, and eta-phase) were observed in low concentration throughout the matrix. 3 refs., 4 figs., 3 tabs.

6953 (DOE/ER—0313/2, pp 213-216) **Microstructural change of JPCA irradiated to 58 dpa at 300°C in HFIR.** Suzuki, M.; Hamada, S.; Tanaka, M.P. (Oak Ridge National Lab., TN; Japan Atomic Energy Research Institute). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Characteristic microstructural features observed in JPCA irradiated at 300°C in HFIR are the formation of many fine bubbles and dislocation loops. Radiation produced MC-type precipitates were found after only 34 dpa irradiation. The present work revealed that bubbles and dislocation loops do not show noticeable change during the irradiation from 34 (helium content: 2470 appM) to 58 dpa (helium content: 4260 appM). On the other hand, the number density of MC-type precipitates decreased during the irradiation. The microchemical examination of the precipitates showed that the chromium content decreased and the nickel and silicon were enriched during irradiation. 3 refs., 4 figs., 3 tabs.

6954 (DOE/ER—0313/2, pp 217-242) **Mechanical properties and fracture behavior of 20% cold-worked 316 stainless steel irradiated to very high neutron exposures.** Hamilton, M.L.; Huang, F.H.; Garner, F.A.; Yang, W.J.S. (Hanford Engineering Development Lab., Richland, WA; General Electric Co., Sunnyvale, CA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Stainless steels irradiated in EBR-II at temperatures in the range 380 to 500°C tend to exhibit saturation of mechanical properties at relatively low fluence levels. At fluences on the order of 13 to 15 x 10^{22} n/cm² (E > 0.1), however, there is a rapid increase in hardness just after the onset of void swelling. The hardness increase is not attributed just to the voids themselves but rather to an indirect effect of voids on nickel depletion in the alloy matrix. The strong dependence of stacking fault energy on nickel and chromium content and particularly on deformation temperature combine to promote extensive stress-induced formation of ϵ-martensite at room temperature. This leads to a very brittle failure mode characterized as quasi-cleavage. At higher deformation temperatures it leads to a failure mode designated channel fracture. 36 refs., 25 figs., 6 tabs.

6955 (DOE/ER—0313/2, pp 245-246) **Charpy impact properties of V-15Cr-5Ti.** Cannon, N.S.; Hamilton, M.L.; Ermi, A.M. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

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Impact tests have been completed on unirradiated one-third size Charpy specimens of V-15Cr-5Ti. The ductile-to-brittle transition temperature was unexpectedly high, on the order of 130°C. Irradiation of this alloy in FFTF-MOTA in lithium-filled TZM sub-

capsules has also been completed at 385, 420, 520, and 600°C, with damage levels ranging from 10 to 30 dpa. Impact tests on these specimens are now being planned. 2 refs., 1 fig.

6956 (DOE/ER—0313/2, pp 247-249) **Preparation and fabrication of vanadium base alloys.** Hins, A.G.; Thresh, H.R. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

This report describes the processing steps carried out to obtain samples of vanadium alloys for testing. 1 ref., 2 figs. (JDH)

6957 (DOE/ER—0313/2, pp 250-258) **Effect of heat treatment and impurity concentration on the tensile deformation of unirradiated and irradiated vanadium alloys.** Loomis, B.A.; Lee, R.H.; Smith, D.L. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

The effect of heat treatment and impurities on the yield strength, ultimate tensile strength, ductility, and fracture mode for the V-15Cr-5Ti, V-12Cr-5Ti, V-15Ti-7.5Cr, V-20Ti, and V-3Ti-1Si alloys was determined from tensile tests at 20°C. In the case of the V-Cr-Ti alloys in the fully recrystallized condition, the results showed that for the alloys to exhibit ductile fracture on tensile deformation at 20°C, they must be annealed in vacuum (rather than in argon-filled capsules) and contain 800 to 900 ppM oxygen. The V-20Ti and V-3Ti-1Si alloys, which contain 800 to 900 ppM oxygen, exhibited ductile fracture after a recrystallization anneal in vacuum as well as in argon-filled capsules. These results were interpreted as evidence that vanadium alloys containing chromium solute are more susceptible to hydrogen embrittlement. The yield strength of vanadium alloys increased with an increase of the combined titanium and chromium concentration. The total elongation of these alloys was not significantly altered by the change in alloy composition. On the basis of microstructures obtained from ion-irradiated alloys, it was concluded that the V-3Ti-1Si and V-20Ti alloys were not intrinsically more resistant to hardening and embrittlement on neutron irradiation than the V-15Cr-5Ti alloy. 9 refs., 6 figs., 2 tabs.

6958 (DOE/ER—0313/2, pp 259-263) **The formation of titanium tritide in V-20Ti.** Braski, D.N. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

The goal of this work is to simulate the production of helium in vanadium alloys so that they may be evaluated under neutron irradiation conditions for possible future use as a first wall structural material for a fusion reactor. More than expected amounts of ^3He were measured in V-20Ti because of what appeared to be the formation of titanium tritide during the tritium trick procedure. Slightly more ^3He was also measured in warm-worked V-20Ti and other vanadium alloy specimens compared to annealed ones - probably because the diffusion of tritium was assisted by the presence of dislocations. The high-helium contents caused substantial losses in ductility in annealed V-20Ti specimens but had little effect in warm-worked specimens. The formation of titanium tritide in high-titanium-content vanadium alloys should be investigated further. 3 refs., 4 figs., 2 tabs.

6959 (DOE/ER—0313/2, pp 269-274) **Corrosion of vanadium alloys in flowing lithium.** Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

The objective of this program is to investigate the influence of a flowing lithium environment on the corrosion behavior and mechanical properties of structural alloys under conditions of interest for fusion reactors. Corrosion rates are determined by measuring the weight change and depth of internal corrosive penetration as a function of time and temperature. These measurements, coupled with metallographic evaluation of the alloy surface, are used to establish the mechanism and rate-controlling processes for the corrosion reactions. Initial effort on mechanical properties is focused on fatigue and tensile tests in flowing lithium environment of controlled purity. Corrosion data are presented for several vanadium alloys exposed to flowing lithium at 482 and 427°C. Metallographic evaluation of the exposed specimens is also presented. The influence of alloy composition and exposure conditions on the corrosion behavior of vanadium alloys is discussed. 4 refs., 7 figs., 1 tab.

6960 (DOE/ER—0313/2, pp 275-278) **Thermal convection loop studies in support of mass transport modeling of lithium/12Cr-1MoVW steel systems.** Bell, G.E.; Abdou, M.A.; Tortorelli, P.F. (Univ. of California, Los Angeles; Oak Ridge National Lab., TN). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

The objective of this research is to provide experimental data and information for development of, and comparison with, an analytical model of the mass transport processes of 12Cr-1MoVW steel over the range of 350 to 650° in the presence of thermally convective lithium. Chemical and metallurgical changes in the system will be closely monitored throughout the test period with particular emphasis placed on the initial 500 h to provide data on the transient chemical and weight loss mechanism kinetics. The analytical model will include chemical and transport mechanisms not previously investigated for liquid lithium mass transport in ferrous alloy systems including chemical and particle dynamics and initial system transient modeling. 2 refs., 4 figs., 3 tabs.

6961 (DOE/ER—0313/2, pp 279-287) **Thermal gradient mass transfer in ferrous alloy Pb-17 at. % Li systems.** Tortorelli, P.F. Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Scanning electron microscopy and associated energy dispersive x-ray analysis of type 316 stainless and 12Cr-1MoVW steels exposed to thermally convective Pb-17 at. % Li yielded quantitative information about changes in surface morphology and composition as a result of mass transfer reactions. In the case of type 316 stainless steel, substantial preferential dissolution of nickel and chromium occurred at 500°C and led to the formation of a deep corrosion zone of irregular penetration. The extent and morphology of this corrosion zone was found to be sensitive to the starting microstructure of the steel. The 12Cr-1MoVW steel corroded uniformly with no change in its surface concentration. Mass transfer deposits in the type 316 stainless steel system differed depending on their position in the cold leg, where the temperature varied from 400 to 460°C. Depending on the temperature, the majority of the deposits were principally composed of iron, iron-nickel, or chromium. 3 refs., 8 figs., 1 tab.

6962 (DOE/ER—0313/2, pp 291-293) **Model of tritium transport in ceramic breeder materials.** Kopasz, J.P.; Johnson, C.E. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

A computer model of tritium transport and release is being developed. The model considers diffusion through the solid and desorption from the solid surface. The model is based on a differential equation that predicts heat transfer in a solid sphere at constant heat generation and heat radiation at the surface. The tritium release over time calculated with our model was compared with the measured release for samples of Li_2SiO_3 from the LISA-1 experiment. Overall agreement between the model and experiment was good. 2 refs., 1 fig.

6963 (DOE/ER—0313/2, pp 294-297) **Adsorption, solution, and desorption characteristics of the $LiAlO_2$-H_2O system.** Fischer, A.K.; Johnson, C.E. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

Isotherms are reported for adsorption of H_3O on $LiAlO_2$ at 500°C and for solubility of OH^- in $LiAlO_2$ also 500°C. The kinetics of the water evolution process appears to be second order in hydroxide content. Calculations have indicated that for the solid phase there is a critical oxygen activity below which tritide is the dominant tritium species rather than tritons which prevail above the critical oxygen activity. These relationships have important implications for the design, performance, and interpretation of tritium release experiments. 2 refs., 4 figs.

6964 (DOE/ER—0313/2, pp 298) **Solid breeder fabrication and mechanical properties.** Poeppel, R.B. (Argonne National Lab., IL). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

6965 (DOE/ER—0313/2, pp 304) **Irradiation effects on organic insulators.** Kasen, M.B. (National Bureau of Standards, Boulder, CO). Sep 1987. NTIS, PC A13/MF A01. Order Number DE88001486/JAW. (ORNL/M—353).

In Fusion reactor materials: Semiannual progress report for the period ending March 31, 1987.

6966 (DOE/ER/53192—B-7) **Experimental studies on the Auburn Torsatron: Progress report.** Gandy, R.F.; Swanson, D.G. (Auburn Univ., AL (USA). Dept. of Physics). Oct 1987. Contract FG05-85ER53192. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002426/JAW.

Progress on the Auburn Torsatron is discussed in this report. In particular, experiments are described dealing with methods of surface mapping the magnetic configuration, plasma confinement studies, ion cyclotron heating and modification to the device. (LSP)

6967 (DOE/ER/53220—T2, pp 4-13) **Ion acceleration in the plasma source sheath.** Birdsall, C.K. 1986. NTIS, PC A04/MF A01. Order Number DE88000412/JAW.

In Plasma theory and simulation: Third and fourth quarterly progress report, July 1, 1986-December 31, 1986.

This note is a calculation of the potential drop for a planar plasma source, across the source sheath, into a uniform plasma region defined by vector $E = 0$ and/or perhaps $\partial^2 PHI/\partial x^2 = 0$. The calculation complements that of Bohm who obtained the potential drop at the other end of a plasma, at a planar collector sheath. The result is a relation between the source ion flux and the source sheath potential drop and the accompanying ion acceleration. This planar source sheath ion acceleration mechanism (or that from a distributed source) can provide the pre-collector-sheath ion acceleration as found necessary by Bohm. 3 refs.

6968 (EGG-EP—7751) **Population projections, 0 to 50 mile radius from the CIT [Compact Ignition Tokamak] facility: Supplementary documentation for an environmental assessment for the CIT at PPPL.** Bentz, L.K.; Bender, D.S. (Bentz (L.K.) Associates, Pittstown, NJ (USA)). Jul 1987. Contract AC07-76ID01570. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002197/JAW.

This report contains estimates for current and projected population distributions for a 50-mile radius area around the Princeton Plasma Physics Laboratory (PPPL) in central New Jersey. It was prepared as supplemental information for an environmental assessment for the proposed Compact Ignition Tokamak facility at PPPL. The report contains estimates for the 1985 population, as well as projections for 1995, 2000, 2005 and 2010. Estimates are provided for municipalities and counties in the area, as well as for a sectorized annular grid centered at PPPL. Sectorized maps are included. An appendix contains technical details on the methodology used. 17 refs., 10 figs., 13 tabs.

6969 (EGG-EP—7752) **Socioeconomic information, Plainsboro area, New Jersey: Supplementary documentation for an environmental assessment for the CIT [Compact Ignition Tokamak] at PPPL.** Bentz, L.K.; Bender, D.S. (Bentz (L.K.) Associates, Pittstown, NJ (USA)). Jul 1987. Contract AC07-76ID01570. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002195/JAW.

This report contains socioeconomic information on the Plainsboro, New Jersey, area, the proposed location of the Compact Ignition Tokamak (CIT) facility. It was prepared as supplemental information for an environmental assessment for the CIT at Princeton Plasma Physics Laboratory (PPPL). The report contains descriptions of the demographic, economic, and community resource characteristics, and, based on information available in early 1987, considers the socioeconomic effect of the proposed facility. In all areas examined, the anticipated socioeconomic impacts of the proposed CIT facility at PPPL are negligible or minimal. 29 refs., 8 figs., 24 tabs.

6970 (EGG-FSP—7848) **Safety and environmental requirements and design targets for TIBER-II .** Piet, S.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002196/JAW.

A consistent set of safety and environmental requirements and design targets was proposed and adopted for the TIBER-II (Tokamak Ignition/Burn Experimental Reactor) design effort. TIBER-II is the most recent US version of a fusion experimental test reactor (ETR). These safety and environmental design targets were one contribution of the Fusion Safety Program in the TIBER-II design effort. The other contribution, safety analyses, is documented in the TIBER-II design report. The TIBER-II approach, described here, concentrated on logical development of, first, a complete and consistent set of safety and environmental requirements that are likely appropriate for an ETR, and, second, an initial set of design targets to guide TIBER-II. Because of limited time in the TIBER-II design effort, the iterative process only included one iteration - one set of targets and one design. Future ETR design efforts should therefore build on these design targets and the associated safety analyses. 29 refs., 5 figs., 3 tabs.

6971 (ENEA-RT-FUS—87-7) **Anomalous heat transport in ohmically heated tokamaks.** Romanelli, F. (ENEA, Rome (Italy)). 1987. 35p. (CONF-8704170—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700757/JAW.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

A model is proposed for the anomalous thermal transport in tokamaks. The effect of the trapped electron dynamics and of the ion temperature gradient driven modes are taken into account in the electron and respectivily ion channels. The model reproduces the Neo Alcator scaling, the saturation of the energy confinement time with density, and recent ion temperature profile measurements performed on Doublet III in the presence of additional heating.

6972 (ENEA-RT-FUS—87-10) **Magnetic influence on fission chambers.** Bertalot, L. (ENEA, Frascati, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700758/JAW.

On large tokamak devices neutron measurements are performed by means of fission chambers can be affected because of the presence of high magnetic fields (E * B drift). A study has been carried out of the magnetic field influence on the fission chamber performances. By means of code, the drift properties of the electrons have been evaluated at different values of crossed E and B fields. The application of incore fission chambers on large tokamak devices results feasible.

6973 **(ENEA-RT-FUS—87-11) Feasibility study of incore fission chamber application for neutron flux measurements on the NET blanket.** Bertalot, L. (ENEA, Frascati, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700759/JAW.

A feasibility study has been carried out on the use of in-core fission chambers as neutron diagnostic tools to perform neutron flux measurements on the blanket component of NET. The high neutron and gamma fluxes and the severe thermal-mechanical and magnetic conditions of the blanket structure have been taken into account in this analysis. Preliminary design criteria and specifications of an in-core detector are presented for NET application. A research and development programme is outlined which aims to obtain more information on the tecnological constraints arising from the severe conditions of the NET blanket. 24 refs.

6974 (INIS-BR—897, pp 103) **Investigation of FRC (Field Reversed Configuration) formation.** Zhang, B.; Li, Y.; Chen, Z.; Ye, M.; Wu, C. (Academia Sinica, Beijing, BJ, China. Inst. of Physics). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-8708185—).

From Energy independence conference: fusion energy and plasma physics; Rio de Janeiro, RJ, Brazil (17 Aug 1987).

6975 **(ITEF—27(1986)) Flame propagation in the approximation of straight-line trajectories of burning products.** Basko, M.M.; Bud'ko, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700675/JAW.

Equations are derived which describe the propagation of subsonic burning waves due to the finite straight-line range of fast reaction products. A detailed analysis of the flame propagation is performed for a step-like temperature dependence of the burning reaction rate. The numerically calculated values of the normal flame velocity for deuterium-tritium mixture are also presented. 5 refs.; 3 tabs.

6976 **(ITEF—28(1986)) Diffusion description of flame propagation due to the translational motion of burning reaction products.** Basko, M.M.; Bud'ko, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700676/JAW.

Equations are derived which describe the propagation of subsonic burning waves due to the straight-line motion of fast particles (the products of burning reaction) in two approximations - the diffusion approximation and the so called α-conductivity approximation. The values of the normal flame velocity are calculated for step-like as well as for a real (corresponding to the fusion reaction of the deuterium-tritium mixture) burning functions. The diffusion approximation is shown to be in a close agreement with the solutions of the rigorous kinetic equation and to require no flux limit. 6 refs.; 2 tabs.

6977 **(KFK—4255) Multi-dimensional neutronics analysis of the 'canister blanket' for NET.** Fischer, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Apr 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750553/JAW.

At KfK a design of a helium-cooled ceramic breeder blanket, called 'canister blanket', has been developed for the NET fusion test reactor. In this report a detailed neutronic analysis of the 'canister blanket', based on one-, two- and three-dimensional Monte-Carlo calculations in the NET-III double null configuration, is presented. The main object refers to the three-dimensional analysis of a complete sector of the NET-reactor containing the 'canister blanket'. This concerns the poloidal distribution of the neutron wall load and the neutron fluxes at the first wall, the spatial distribution of the power density, the total power production and global effects on the tritium breeding ratio. It is shown that, in case of the 'canister blanket', a global tritium breeding ratio beyond 1.0 seems to be feasible for NET.

6978 **(KFK—4276) Nuclear fusion project. Semi-annual report of the Association KfK/EURATOM. October 1986 - March 1987.** Kast, G. (comp.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). May 1987. 84p. (In English). (EUR—10535e). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751030/JAW.

This semi-annual report gives 36 short descriptions of the work done in the framework of the Nuclear Fusion Project and outlines studies for NET/INTOR and for ECRH power sources at 150 GHz. Tables of fusion technology contracts, of NET contracts, of KfK departments contributing to the Fusion Project, and of the Fusion Project management staff complete this report.

6979 **(KFK—4292) 3D Monte Carlo simulation of molecular movement and heat radiation in vacuum devices - computer code MOVAK3D.** Class, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Jul 1987. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750554/JAW.

For fusion reactors the accuracy of design of the vacuum flow channels is important because it exerts an influence on tritium breeding and neutron shielding due to the neutron leakage. In these channels the motion of the gas molecules is determined mainly by molecular diffusion with very long free paths. If cryopumps are used the shine through of thermal radiation must also be taken into account. The quantitative analysis of these phenomena is preferably performed by means of Monte Carlo methods, which also provide the possibility of taking into account a finite free path of the gas particles. The three-dimensional MOVAK3D computer code for simulation of these phenomena is written in PL/I and verified using published data. Computer aided input of model data is performed interactively either under IBM-TSO or at a microprocessor (IBM PC-AT). The data files are exchangeable between the IBM-mainframe and IBM-PC computers. Both computers are capable of producing plots of the elaborated channel model. For testing purposes the simulating computation can likewise be run interactively, whereas the production computation can be issued batchwise. The inner surface of the flow channel is described by plane areas (triangles, parallelograms) and by surfaces of revolution. By introducing control planes in the flow path a variance reduction and shortening of the computation, respectively, are achieved through particle splitting and Russian roulette. After presentation of the fundamentals the results of code verification are explained and, finally, examples of channel models and of the interactive mode are given.

6980 **(LA-UR—87-3323) A multi-channel, optically coupled spark gap monitor system.** Gribble, R.; Barnes, G.A. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 4p. (CONF-871007—15). NTIS, PC A02. Order Number DE88001851/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A spark gap monitor system has been installed on FRX-C Large Source Modification, a theta pinch experiment which forms field-reversed configuration (FRC) compact toroids. The field reversing theta pinch produces a vacuum magnetic field of 10kG inside the single turn, 2-m-long straight 0.7-id coil by discharging in series two 50kV, 200μF capacitor banks with a total of 140 2.8μF capacitors each with a start spark-gap switch and a "piggy-back" crowbar spark-gap switch. Efficient operation of the bank requires information on the timing and function of each capacitor-spark gap unit. Diagnosing the capacitor-spark-gap unit load cable current (approximately 3kA per cable) is complicated by the fact that the ground return for the capacitor is of a relatively high impedance. Units that are allowed to prefire or postfire not only degrade the performance of the bank but will self destruct or destroy their neighbors. To provide this information without introducing high voltage transients into the data acquisition and control system as optically coupled, 140 channel gap monitor system has been in-

stalled. Simplicity and reliability were key requirements in the design of the system. A resistor made of thin wall stainless steel tubing replaces a short section of the braid on one load cable on each capacitor. The voltage developed across the resistor provides the current source to drive an LED. The relatively linear output from the LED is transmitted through approximately 30m of fiber optic cable to the FRX-C control room. The signal is received by a photo diode and simple amplifier circuit that feeds the signal into a 12 channel charge integrating ADC CAMAC module for processing by the computer. The information provided by this system informs the operator as to when and how each gap fired. 2 refs., 8 figs.

6981 **(LA-UR—87-3346) Overview of tritium systems for the Compact Ignition Tokamak.** Bartlit, J.R.; Gruetzmacher, K.M.; Fleming, R.B. (Los Alamos National Lab., NM (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1987. Contract W-7405-ENG-36. 13p. (CONF-871007—34). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001846/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Compact Ignition Tokamak (CIT) is being designed at several laboratories to produce and study fully ignited plasma discharges. The tritium systems which will be needed for CIT include fueling systems and radiation monitoring and safety systems. Design of the tritium systems is the responsibility of the Tritium Systems Test Assembly (TSTA) at Los Alamos National Laboratory. Major new tritium systems for CIT include a pellet injector, an air detritiation system and a glovebox atmosphere detritiation system. The pellet injector is being developed at Oak Ridge National Laboratory. 7 refs., 2 figs.

6982 **(LA-UR—87-3396) Results of tritium experiments on ceramic electrolysis cells and palladium diffusers for application to fusion reactor fuel cleanup systems.** Carlson, R.V.; Binning, K.E.; Konishi, S.; Yoshida, H.; Naruse, Y. (Los Alamos National Lab., NM (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tritium Engineering Lab.). 1987. Contract W-7405-ENG-36. 8p. (CONF-871007—42). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001837/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Tritium tests at the Tritium Systems Test Assembly have demonstrated that ceramic electrolysis cells and palladium alloy diffuser developed in Japan are possible components for a fusion reactor fuel cleanup system. Both components have been successfully operated with tritium for over a year. A failure of the first electrolysis cell was most likely the result of an over voltage on the ceramic. A simple circuit was developed to eliminate this mode of failure. The palladium diffusers tubes exhibited some degradation of mechanical properties as a result of the build up of helium from the tritium decay, after 450 days of operation with tritium, however the effects were not significant enough to affect the performance. New models of the diffuser and electrolysis cell, providing higher flow rates and more tritium compatible designs are currently being tested with tritium. 8 refs., 5 figs.

6983 **(LA-UR—87-3416) Cost reduction possibilities for a heavy-ion accelerator for inertial confinement fusion.** Thayer, G.R.; Sims, J.R.; Henke, M.D.; Harris, D.B.; Dudziak, D.J.; Phillips, N.R. (Los Alamos National Lab., NM (USA); BDM Corp., Albuquerque, NM (USA)). Oct 1987. Contract W-7405-ENG-36. 52p. (CONF-871007—35). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001836/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A design was produced for a single module in a cost-optimized accelerator appropriate for a commercial heavy-ion power plant. The goal of the study was to determine if the cost of the accelerator module could be reduced through design options, selection of materials, and manufacturing techniques. Independent cost estimates were obtained for the three main components of the module, and cost reductions of 20% from the cost calculated by the heavy-ion accelerator design/cost-minimization computer code LIACEP were identified. 3 refs., 23 figs.

6984 **(LA-UR—87-3425) Heat flux estimates and armor design for CPRF/ZTH.** Downing, J.N.; Werley, K.A.; Gamble, M.T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-871007—30). NTIS, PC A02. Order Number DE88001834/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A model for the scrape-off layer (SOL) in Reversed-Field Pinches (RFPs) was developed to evaluate the wall heat flux distribution in CPRF/ZTH. Design options for high heat flux areas have been evaluated. A finite element model was used to determine the front-surface temperature and the thermally-induced stresses in the graphite. 2 refs., 10 figs.

6985 **(LA-UR—87-3428) System support software for TSTA [Tritium Systems Test Assembly].** Claborn, G.W.; Mann, L.W.; Nielson, C.W. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 4p. (CONF-871007—31). NTIS, PC A02. Order Number DE88001833/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The fact that Tritium Systems Test Assembly (TSTA) is an experimental facility makes it impossible and undesirable to try to forecast the exact software requirements. Thus the software had to be written in a manner that would allow modifications without compromising the safety requirements imposed by the handling of tritium. This suggested a multi-level approach to the software. In this approach (much like the ISO network model) each level is isolated from the level below and above by cleanly defined interfaces. For example, the subsystem support level interfaces with the subsystem hardware through the software support level. Routines in the software support level provide operations like "OPEN VALVE" and CLOSE VALVE" to the subsystem level. This isolates the subsystem level from the actual hardware. This is advantageous because changes can occur in any level without the need for propagating the change to any other level. The TSTA control system consists of the hardware level, the data conversion level, the operator interface level, and the subsystem process level. These levels are described.

6986 **(LA-UR—87-3429) Subsystem software for TSTA [Tritium Systems Test Assembly].** Mann, L.W.; Claborn, G.W.; Nielson, C.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-871007—36). NTIS, PC A02. Order Number DE88001832/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Subsystem Control Software at the Tritium System Test Assembly (TSTA) must control sophisticated chemical processes through the physical operation of valves, motor controllers, gas sampling devices, thermocouples, pressure transducers, and similar devices. Such control software has to be capable of passing stringent quality assurance (QA) criteria to provide for the safe handling of significant amounts of tritium on a routine basis. Since many of the chemical processes and physical components are experimental, the control software has to be flexible enough to allow for trial/error learning curve, but still protect the environment and personnel from exposure to unsafe levels of radiation. The software at TSTA is implemented in several levels as described in a preceding paper in these proceedings. This paper depends on information given in the preceding paper for understanding. The top level is the Subsystem Control level.

6987 **(LA-UR—87-3431) PF magnetic design for the 4MA reversed field pinch experiment CPRF.** Gribble, R.F.; Rogers, J.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871007—37). NTIS, PC A02. Order Number DE88001831/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

ZTH is to reach 2 MA by inductive energy transfer in 0.05 s followed by power supply ramping to 4 MA in 0.4 s. Major and minor radii are 2.4 and 0.4 m. Copper for the poloidal field coils weighs 48 metric tonnes, the one-turn equivalent ohmic heating (OH) coil inductance is 1.90 μH, and the OH coil rating is 15.4 MAT, 225 MJ, and 29.3 Vs at 60 kA. The normal operating OH current is 50 kA. Design of the coil for 60 kA provides a margin for uncertainties. OH coils are connected in series and the combination is connected in parallel with four equilibrium field (EF) coils. With optimized location of all coils, this connection provides decoupling between the OH and EH coil sets so that the changing OH current does not affect EF winding current. 3 refs., 2 figs., 1 tab.

6988 **(LA-UR—87-3465) The TITAN Reversed-Field Pinch Reactor: Design-point determination and parametric studies.** Miller, R.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-871007—40). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001824/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The multi-institutional TITAN study has examined the physics, technology, safety, and economics issues associated with the operation of a Reversed-Field Pinch (RFP) magnetic fusion reactor at high power density. A comprehensive system and trade study have been conducted as an integral and ongoing part of the reactor assessment. Attractive design points emerging from these parametric studies are subjected to more detailed analysis and design integration, the results of which are used to refine the parametric systems model. The design points and tradeoffs for two TITAN/RFP reactor embodiments are discussed. 14 refs.

6989 **(LA-UR—87-3466) The TITAN oscillating-field current-drive system.** Bathke, C.G. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 5p. (CONF-871007—41). NTIS, PC A02. Order Number DE88001823/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The TITAN study uses oscillating-field current drive (OFCD) for steady-state operation in a reversed-field-pinch (RFP) fusion reactor. A circuit model which simulates the plasma, first wall, blanket, and coils has been developed and applied to two TITAN reactor designs to assess OFCD efficiency and power-supply requirements. Methods for optimizing current-drive efficiency and minimizing power-supply requirements have been identified. 15 refs.

6990 **(LA-UR—87-3467) Connections between physics and economics for tokamak fusion power plants.** Krakowski, R.A.; Delene, J.G. (Los Alamos National Lab., NM (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-871007—29). NTIS, PC A02. Order Number DE88001815/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A simplified physics, engineering, and costing model of a tokamak fusion reactor is used to examine quantitatively the connection between physics performance and power-plant economics based on a DT-fuelled tokamak reactor. Areas where physics and technology advances are needed and where physics/technology tradeoffs exist for attractive end-products are quantitatively identified. 24 refs., 5 figs., 2 tabs.

6991 **(LA-UR—87-3477) Preliminary design of the energy system for the ZTH experiment.** Boenig, H.; Gribble, R.; Hammer, C.; Huddleston, S.; Kewish, R.; Konkel, H.; Melton, J.; Reass, W.; Rosev, B.; Thullen, P. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 5p. (CONF-871007—20). NTIS, PC A02. Order Number DE88001789/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A 4 MA reversed field pinch experiment, called ZTH, is being designed and built at Los Alamos. The first plasma discharges are scheduled to take place in FY 1991. Major electrical power equipment components, such as a pulsed generator, controlled power supplies, isolation and opening switches, current interrupters and capacitor banks are being designed and procured for this experiment. In this paper the requirements and the design philosophy of the components for the energy system are described, and a status report on the component acquisition is given. 7 figs.

6992 **(LA-UR—87-3591) The design of an isotope separation system for JET.** Sherman, R.H. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 5p. (CONF-871007—19). NTIS, PC A02. Order Number DE88001797/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Cryogenic distillation is planned as one of the processes to be used for isotope separation at JET. Three possible configurations of columns for this service are presented and discussed. The ability to easily control a system of columns must weigh heavily in the final selection of a process for construction. 5 refs., 6 figs., 6 tabs.

6993 (LBL—23168, pp 5-9) **The LBL multiple beam experiments.** Fessenden, T.J.; Keefe, D.; Kim, C.; Meuth, H.; Warwick, A. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

The multiple-beam induction linac approach to a heavy ion driver for inertial confinement fusion features continuous current amplification along the accelerator and a minimum of beam manipulations from source to pellet. Current amplification and bunch length control require careful shaping of the accelerating voltages. MBE-4 is designed as a four-beam induction linac that models much of the accelerator physics of the electrostatically focused section of a significantly longer induction accelerator. Four space-charge-dominated Cs^+ beams, initially about one meter in length at a current of 13 mA, are focused by electrostatic quadrupoles and accelerated in parallel from 200 to nearly 600 keV. The energy will reach approximately one MeV when the accelerator is complete. Experiments have proceeded in parallel with the construction of the apparatus which began in FY 85 and is now more than half complete. The results show a current amplification, so far, by a factor of 2.8 in good agreement with the longitudinal acceleration calculations. 9 refs.

6994 (LBL—23168, pp 17-21) **The effect of nonlinear forces on coherently oscillating space-charge-dominated beams.** Celata, C.M. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

A particle-in-cell computer simulation code has been used to study the transverse dynamics of nonrelativistic misaligned space-charge-dominated coasting beams in an alternating gradient focusing channel. In the presence of nonlinear forces due to dodecapole or octupole imperfections of the focusing fields or to image forces, the transverse rms emittance grows in a beat pattern. Analysis indicates that this emittance dilution is due to the driving of coherent modes of the beam near their resonant frequencies by the nonlinear force. The effects of the dodecapole and images forces can be made to effectively cancel for some boundary conditions, but the mechanism is not understood at this time. 6 refs.

6995 (LBL—23168, pp 25-27) **Transverse combining of nonrelativistic beams in a multiple beam induction linac.** Celata, C.M.; Faltens, A.; Judd, D.L.; Smith, L.; Tiefenback, M.G. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

Emittance growth of beams during transverse combining has been studied computationally and experimentally for Heavy Ion Fusion applications, and the theory and results are presented. A hardware design is also discussed. 3 refs.

6996 (LBL—23168, pp 28-30) **Comparison of electric and magnetic quadrupole focusing for the low energy end of an induction-linac-ICF driver.** Kim, C.H. Apr 1987. NTIS, PC A03. Order Number DE87013971/JAW.

In Heavy ion fusion accelerator research (HIFAR) half-year report: October 1, 1986-March 31, 1987.

In this report we compare two physics designs of the low energy end of an induction-linac-ICF driver: one using electric quadrupole focusing of many parallel beams followed by transverse beam combining; the other using magnetic quadrupole focusing of fewer beams without beam combining. Because of larger head-to-tail velocity spread and a consequent rapid current amplification in a magnetic focusing channel, the overall accelerator size of the design using magnetic focusing is comparable to that using electric focusing. 8 refs.

6997 (SAND—87-1232) **Magnetic fusion energy-high heat flux publications and related reports: A bibliography.** Tolendino, C.D. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002822/JAW.

This document is a collection of abstracts of papers prepared as part of the Sandia program of High Heat Flux Materials and Component Development categories, namely those relating to materials and those relating to Components, and include both review papers and numerous papers relating specific results. Copies of these reports can be obtained by contacting the editor or the authors directly.

6998 (SAND—87-2653C) **The APEX Project: Ion beam pulse-shaping experiments on Sandia Laboratories' Particle Beam Fusion Accelerator PBFA II.** Crow, J.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 21p. (CONF-871173—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002224/JAW.

From 3. ICF system and applications colloquium; Madison, WI, USA (9 Nov 1987).

This paper discusses the development of ion beam pulse shaping, efficient extraction ion diodes, and efficient plasma channel transport for the particle beam fusion accelerator PBFA II. 10 refs. (LSP)

6999 (UCID—21080-86) **Low-density hydrocarbon foams for laser fusion targets: Progress report, 1986.** Chen, C.; Cook, R.C.; Haendler, B.L.; Hair, L.M.; Kong, F.M.; Letts, S.A. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001876/JAW.

We describe progress made during 1986 in the development of direct-drive hydrocarbon foam targets for laser fusion. The foam materials are polystyrene and resorcinolformaldehyde. The processes for making the foams, their properties, characterization techniques, and the relationships of their properties to target specifications are presented. In the final section, we discuss statistical experimental design techniques that are being used to optimize the foams. 12 refs., 14 figs., 2 tabs.

7000 (UCRL—15974) **Rayleigh-Taylor growth of bumps on inertial confinement fusion targets: Final report.** Montierth, L.; Morse, R. (Arizona Univ., Tucson (USA). Dept. of Nuclear and Energy Engineering). Oct 1987. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002472/JAW.

The purpose of this paper is to demonstrate a technique for determining the spatial and temporal evolution of surface imperfections which are composed of a spectrum of wavelengths using results from these linear studies. These surface imperfections, or bumps, may result from target fabrication techniques or may be intentionally inscribed on the target's surface for use in instability experiments. For the purposes of this paper we assume a particular spatial shape for the bump although the technique is applicable to other bump shapes. While the results are only valid during the linear phase of the instability, estimates can be obtained for predicting when the transition to nonlinear behavior might occur. 6 refs., 28 figs.

7001 (UCRL—94625) **Demountable vacuum seals for fusion reactor applications.** Batzer, T.H.; Call, W.R. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—23). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001894/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Demountable vacuum seals for fusion reactor applications must be compatible with the reactor environment, easily scalable, very reliable and readily maintained by remote handling methods. We are investigating gate valves as well as flanges in our efforts to provide such seals. They are all metal and scalable without becoming massive and require no axial fasteners. Preliminary tests on an initial 30 cm aluminum flange using no soft metal coatings or gaskets have given several vacuum tight closures. Weld fatigue of this preliminary design caused degradation of the seal with further cycling to leakage levels of 10^{-6} Tl/sec, which is acceptable with differential pumping for either valves or flanges. Additional flange pairs using slightly altered geometry, fabrication techniques, and seal plating materials will be tested and reported on.

7002 (UCRL—96268) **High speed detection of thermonuclear neutrons with solid state detectors.** Kania, D.R.; Lane, S.; Jones, B.; Bennett, C.; Prussin, S.; Detzon, M.S. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA)). Oct 1987. Contract W-7405-ENG-48. 10p. (CONF-871006—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001883/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Inertial confinement fusion experiments generate thermonuclear neutrons on subnanosecond time scales. To understand the burning of DT fuel, we have developed a 14 MeV neutron detector with subnanosecond time response. The detectors are made of neutron damaged, bulk GaAs with electron-hole recombination times of 60 ps. The conductivity of the detector is modulated by the energy deposited by the neutrons interacting in the detector that create free carriers. The fast electron hole recombination time of this material quickly removes these radiation generated carriers from the conduction process resulting in extremely fast response times. The measurements and calculations of the sensitivity of these detectors to 14 MeV neutrons are in good agreement. 3 refs., 1 fig.

7003 (UCRL—96569) **A low jitter, low cost, time-of-flight circuit.** Cable, M.D.; Derzon, M.S.; Vieira, R.G.; Spracklen, H.P. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 4p. (CONF-871005—3). NTIS, PC A02. Order Number DE88001879/JAW.

From Nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A low cost circuit has been developed for use in a neutron time-of-flight spectrometer at the Nova Laser Facility. Using a silicon charged-particle detector, amplifier and constant-fraction discriminator, timing resolution of better than 50 ps FWHM has been achieved. Using an array of many such detectors, very high data rates and precise spectra can be obtained. 3 refs., 2 figs.

7004 (UCRL—96677) **The edge plasma and divertor in TIBER.** Barr, W.L. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—46). NTIS, PC A02. Order Number DE88001661/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

An open divertor configuration has been adopted for TIBER. Most recent designs, including DIII-D, NET and CIT use open configurations and rely on a dense edge plasma to shield the plasma from the gas produced at the neutralizer plate. Experiments on ASDEX, PDX, D-III, and recently on DIII-D have shown that a dense edge plasma can be produced by re-ionizing most of the gas produced at the plate. This high recycling mode allows a large flux

of particles to carry the heat to the plate, so that the mean energy per particle can be low. Erosion of the plate can be greatly reduced if the average impact energy of the ions at the plate can be reduced to near or below the threshold for sputtering of the plate material. The present configuration allows part of the flux of edge plasma ions to be neutralized at the entrance to the pumping duct so that helium is pumped as well as hydrogen. 7 refs., 3 figs.

7005 **(UCRL—96689) High-resolution time-resolved x-ray microscope for inertial confinement fusion (ICF) target dynamics experiments.** Ellis, R.J.; Kilkenny, J.D.; Levesque, R.A.; Phillion, D.W.; Deane, D.J. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—26). NTIS, PC A02. Order Number DE88001881/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A versatile x-ray microscope diagnostic has been built to perform target dynamics experiments on the Nova Ten Beam target irradiation facility. This system is based on Wolter's axisymmetric focusing scheme. An alignment system is described which provides for both quick and accurate alignment of the x-ray optic. Results are presented showing the system resolution and accuracy of alignment. Images from target dynamics experiments are also presented. 9 refs.

7006 **(UCRL—96691) Design of the Backscatter Spectroscopy System for the Nova Laser Facility.** Tietbohl, G.L.; Drake, R.P.; Young, P.E. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—48). NTIS, PC A02. Order Number DE88001880/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

When the laser light is focused onto a target, a number of mechanisms can reflect or scatter the light back through the focus lens. The Backscatter Spectroscopy System (BSS) is a diagnostic that measures the properties of this reflected or scattered light. Just before the main focus lens on each of the ten Nova arms is a KDP crystal array for converting the 1 μm laser light to shorter harmonic wavelengths. This array rotates ~10° about the beam axis to select the 351 nm wavelength where most of the experiments are run. The BSS consists of a fused silica plate inserted into one of the beam lines before the KDP array. The reflector plate is shaped like one of the array elements and is aligned with it to minimize the effects of diffraction. The plate is mounted in a mechanism to allow alignment, as well as rotation with the KDP array when the converted wavelength is changed. The plate is mounted 10° off normal so that light can be reflected out of the beam tube. Roughly 4% of target-reflected light reflects off this plate and is transported to an optics table where it is analyzed. To transport the light to the optics table, an alignment insensitive relay lens system is used with a vacuum cell and turning mirrors. The instrumentation on the table includes a 0.5 meter spectrometer with an optical streak camera for time-resolved spectral information, a small photodiode array for intensity data, and a film pack for beam structure and system alignment information. 1 ref., 5 figs.

7007 **(UCRL—96722) TIBER II [Tokamak Ignition/Burn Experimental Reactor] baseline operation.** Devoto, R.S.; Fenstermacher, M.E.; Logan, B.G. (Lawrence Livermore National Lab., CA (USA); National Magnetic Fusion Energy Computer Center, Livermore, CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—43). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001887/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The plasma properties of the baseline operation of the TIBER II/ETR design are presented. Noninductive current drive is obtained from the combination of a high-energy neutral beam in the core, lower hybrid radio frequency waves on the edge and neoclassical effects. The de .ign yields an average neutron wall loading of 1.3 MW/m², a Q (= fusion power/input power) of 5 and an expected fluence of 3 MW-y/m². 14 refs., 3 figs., 2 tabs.

7008 **(UCRL—96814) Modeling of thermal effects on TIBER II [Tokamak Ignition/Burn Experimental Reactor] divertor during plasma disruption.** Bruhn, M.L.; Perkins, L.J. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001893/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Mapping the disruption power flow from the mid-plane of the TIBER Engineering Test Reactor to its divertor and calculating the resulting thermal effects are accomplished through the modification and coupling of three presently existing computer codes. The resulting computer code TADDPAK (Thermal Analysis Divertor during Disruption PAcKage) provides three-dimensional graphic presentations of time and positional dependent thermal effects on a poloidal cross section of the double-null-divertor configured reactor. These thermal effects include incident heat flux, surface temperature, vaporization rate, total vaporization, and melting depth. The dependence of these thermal effects on material choice, disruption pulse shape, and the characteristic thickness of the plasma scrape-off layer is determined through parametric analysis with TADDPAK. This computer code is designed to be a convenient, rapid, and user-friendly modeling tool which can be easily adapted to most tokamak double-null-divertor reactor designs. 14 refs.

7009 **(UCRL—96873) Overview of the TIBER II [Tokamak Ignition/Burn Experimental Reactor] design.** Henning, C.D.; Logan, B.G. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 7p. (CONF-871007—21). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001892/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The TIBER II Tokamak Ignition/Burn Experimental Reactor design is the result of efforts by numerous people and institutions, including many fusion laboratories, universities, and industries. While subsystems will be covered extensively in other reports, this overview will attempt to place the work in perspective. Major features of the design are compact size, low cost, and steady-state operation. These are achieved through plasma shaping and innovative features such as radiation tolerant magnets and optimized shielding. While TIBER II can operate in a pulsed mode, steady-state is preferred for nuclear testing. Current drive is achieved by a combination of lower hybrid and neutral beams. In addition, 10 MW of ECR is added for disruption control and current drive profiling. The TIBER II design has been the US option in preparation for the International Thermonuclear Experimental Reactor (ITER). Other equivalent national designs are the NET in Europe, the FER in Japan and the OTR in the USSR. These designs will help set the basis for the new international design effort. 9 refs.

7010 **(UCRL—97491) The application of photoconductive detectors to the measurement of x-ray production in laser produced plasmas.** Kania, D.R.; Bell, P.; Trebes, J. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 13p. (CONF-8708110—26). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001630/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

Photoconductive detectors (PCDs) offer an attractive alternative for the measurement of pulsed x-rays from laser produced plasmas. These devices are fast (FWHM ~100 ps), sensitive and simple to use. We have used InP, GaAs, and Type IIa diamond as PCDs to measure x-rays emission from 100 eV to 100 keV. Specifically, we have used these detectors to measure total radiation yields, corona temperatures, and hot electron generated x-rays from laser produced plasmas. 5 refs., 4 figs.

7011 **High-voltage high-power resistive divider for TFTR neutral-beam power supply.** Phillips, S.R. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 467-469(Aug 1987).

The neutral-beam source at the Tokamak Fusion Test Reactor (TFTR) requires a voltage divider to supply the gradient grid. The requirements are simple, but stringent: it must dissipate 576 kW of peak power at 120 kV dc. Average power is 19.2 kW. A special resistive divider, indirectly water cooled, has been successfully developed for this purpose. The divider is unusually large physically, weighing 1290 kg when filled, and its cooling system is believed to be unique, conferring unusual advantages. The divider consists of an array of 9000 commercial resistors immersed in a plastic tank of inert fluid. The resistors are cooled by subcooled-pool boiling at their surfaces, and the fluid is vigorously circulated by natural convection. A fluid-to-water heat exchanger above the resistors removes the deposited energy and limits the average temperature of the system. The tank is covered by a constant-pressure diaphragm seal. The heat capacity of the system reliably averages the pulse power, and there are no pumps or other moving parts. Operation of the system, which is intrinsically self-regulating, is relatively unaffected by leakage or noncondensible gas.

7012 **Surface discharges for soft x-ray preionization in light-ion-fusion accelerators.** Woodworth, J.R.; Burns, E.J.T.; Hanson, D.L.; Jaramillo, W.H.; Pattison, D.A. (Sandia National Labs., Albuquerque, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 384-393(Aug 1987). Contract AC04-76DP00789.

The authors investigate surface discharges as extreme ultraviolet (XUV) photon sources for preionizing anode surfaces of ion diodes in light-ion-fusion accelerators. Preionization is important both to control the diode impedance and to efficiently generate an ion beam. The surface discharges and their power feeds were constructed in a strip-line configuration to minimize overall system inductance. In some cases a 0.6-μF peaking capacitor was added to the circuit as close as possible to the surface discharge. These discharges radiated peak XUV powers of over 20 MW and total energies of over 5 J when driven by a low-energy (480 J) capacitor bank. These discharges were used to preionize the anode surface in an Applied-β diode on the Nereus accelerator (500 kV, 40 kA). Preionizing a cleaned LiF anode with 60 kW/cm/sup 2/ of XUV photons resulted in improved beam uniformity, flatter impedance profile, and a factor of 4 more ion beam energy coupled through the diode.

7013 **An investigation of lithium ion sources on an Applied-B extraction diode on a PI-110A accelerator.** Mc Kay, P.F.; Gerber, R.A.; Pregenzer, A.L. (Sandia National Labs., Albuquerque, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-15**: No. 4, 339-345(Aug 1987).

As part of the effort to develop an electrohydrodynamically (EHD) driven lithium ion source for the Particle Beam Fusion Accelerator II (PBFA II) at Sandia National Laboratories, the authors have begun experiments with liquid lithium and liquid lithium nitrate-filled anodes on the PI-110A accelerator. Several methods have been used to provide a lithium or lithium-bearing vertical anode surface that can be maintained above its melting point. They report preliminary results which indicate that a high purity (>80 percent) Li/sup +/ beam is achievable from these anodes. Diagnostics include measurements of diode voltage, diode current, ion current, and a Thomson parabola analyzer to measure ion species. The possibility that ions are produced by an EHD phenomenon is discussed. Other mechanisms of ion production are considered.

7014 **Radiative emission near critical density in laser-produced plasma.** Burkhalter, P.G.; Apruzese, J.P.; Duston, D. (Naval Research Lab., Washington, DC 20375-5000). pp 170-196 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

Experimental and theoretical spectroscopic techniques were used to determine temperature, density, and emission profiles in laser-produced plasmas. Spatially-resolved, high resolution x-ray spectra were acquired from shots using 0.53 and 1.06 μm laser light. Plasma temperatures and densities were interpreted with a collisional-radiative equilibrium ionization model incorporating multifrequency radiative transport and a 1-D planar hydrodynamic plasma expansion model. Effects of plasma opacity on line shapes, resonance line ratios, and satellite/parent line intensities were studied as a function of tracer dot diameter.

7015 **Argon puff gas soft X-ray laser.** Davis, J.; Apruzese, J.P.; Agritellis, C.; Kepple, P. (Plasma Physics Div., Plasma Radiation Branch, Naval Research Lab., Washington, DC 20375). pp 197-229 of Radiative properties of hot dense matter III. Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8510172—).

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

A non-LTE dynamic argon pinch model has been applied to investigate the feasibility of creating conditions favorable to gain coefficients in excess of unity during the implosion of a cylindrical annular argon gas puff plasma. Preliminary results obtained from the SIMPLODE model suggest that it is possible to achieve measurable gain in the 3p-3s lasing transition at 434 A in neonlike argon.

7016 **Radiation protection for the Particle Beam Fusion Accelerator II, design features and startup experience.** Simmons, T.N.; Mashburn, J.B.; Mix, L.P.; Sinton, D.L.; Sweeney, M.A. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). pp 338-345 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—). Contract AC04-76DP00789.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The Particle Beam Fusion Accelerator II (PBFA II) is an inertial confinement fusion research device designed to deliver a 30 MeV lithium ion beam onto a deuterium, tritium filled pellet with the goal of achieving net energy gain. PFBA II has radiation protection hazards in common with fusion devices and small accelerators. The severity of these hazards will increase with time. Electrons lost in the center section create an intense burst of bremsstrahlung which must be shielded. Some of the bremsstrahlung will initiate (γ, n) reactions, which release neutrons, activate structural materials and create radioactive gases of which N-13 will be most important. Protons accelerated out of plasma in the plasma opening switches initiate (p,n) reactions which release neutrons and create radioactive materials. The lithium beam will create radioactive materials. Imploded tritium targets will release tritium causing contamination problems. Breakeven fusion experiments could release large quantities of 14 MeV neutrons that must be shielded and would induce additional radioactivity. Controls to handle these problems are discussed. Health Physics experience during the first year of operation is related.

7017 **Muon sticking in muon-catalysed d-t fusion.** Takahashi, H. (Brookhaven National Lab., Upton, NY, USA). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 12, L271-L277(Dec 1986).

The effect of low energy resonance of the d-t fusion reaction on the muon sticking factor in muon-catalysed fusion is studied. The sticking factor is formulated using the μ-dt molecular wavefunction and the doorway state wavefunction, which represent the resonance reaction of resonance energy Esub(R) = Esub(r) + iGAMMAsub(r)/2. The sticking factor for a large half width GAMMAsub(r)/2 is the same as the one without taking into account the nuclear reaction, but for a small half width the sticking factor becomes generally small, except for some cases such as Esub(r) = 60 keV and GAMMAsub(r)/2 = 90 keV.

7018 **Atomic processes in fusion plasmas: a report on the Santa Cruz seminar.** Olson, R.E.; Schlachter, A.S. (Missouri Univ., Rolla, USA. Dept. of Physics; Lawrence Berkeley Lab., CA, USA). *Comments on Atomic and Molecular Physics;* **18**: No. 5, 237-258(Sep 1986).

A report is presented on the Santa Cruz Seminar on Atomic Processes in Fusion Plasmas 1985. The topics discussed, summarized in the Comment, include atomic and electronic collision cross sections for modeling ion confinement and transport, and collision mechanisms related to production of ion and atom beams for heating, fueling, and diagnostics of fusion plasmas.

7019 **Hybrid finite difference/finite element solution method development for non-linear superconducting magnet and electrical circuit breakdown transient analysis.** Kraus, H.G.; Jones, J.L. (Idaho National Engineering Lab., Idaho Falls, USA). *International Journal for Numerical Methods in Engineering;* **23**: No. 6, 1003-1022(Jun 1986).

The problem of non-linear superconducting magnet and electrical protection circuit system transients is formulated. To enable studying the effects of coil normalization transients, coil distortion (due to imbalanced magnetic forces), internal coil arcs and shorts, and other normal and off-normal circuit element responses, the following capabilities are included: temporal, voltage and current-dependent voltage sources, current sources, resistors, capacitors and inductors. The concept of self-mutual inductance, and the form of the associated inductance matrix, is discussed for internally shorted coils. This is a Kirchhoff's voltage loop law and Kirchhoff's current node law formulation. The non-linear integrodifferential equation set is solved via a unique hybrid finite difference/integral finite element technique.

7020 **Inertial confinement fusion with light-ion beams.** Devender, J.P. van. (Sandia National Labs., Albuquerque, NM, USA). *Plasma Physics and Controlled Fusion;* **28**: No. 6, vp(Jun 1986).

Intense beam of lithium ions offer an efficient and cost-effective source of power for Inertial Confinement Fusion (ICF) if the beams can be adequately focused on target. In 1984, a proof-of-principle experiment on intense beam focusing with protons demonstrated the required beam-divergence at the required source current density. In 1985, the results were scaled to the total current and source radius required for ignition experiments. Scaling to the correct lithium source purity and energy on the Particle Beam Fusion Accelerator II (BPFA II) is the next step and will begin in 1986. The advances, risks and advantages of light ions for ICF are presented.

7021 **Compression measurements in ablatively driven inertial confinement fusion.** Ze, F.; Suter, L.J.; Lane, S.M. (Lawrence Livermore National Lab., CA, USA). *Comments on Plasma Physics and Controlled Fusion;* **10**: No. 1, 33-41(May 1986).

The results of implosion experiments conducted at the multiterawatt 1.06-μm Shiva and 0.53-μm Novette laser facilities at Lawrence Livermore National Laboratory are presented. The data show evidence of significant increase in the compressed pusher areal density. Using a previously derived simple model based on mass and momentum conservation, we inferred that corresponding fuel densities reached values that were approx.100 times liquid DT density. The highest compressions were obtained with 0.53-μm irradiation, which is attributed to the improved laser-plasma coupling at submicron laser wavelengths. Inferred fuel temperatures were, however, lower than one would expect from such implosions. These results suggest that processes such as mixing, fluid instabilities and implosion symmetry should be vigorously investigated in future work to develop a better understanding of ablatively driven implosions.

7022 **Streaming modes in final beam transport for heavy ion beam fusion.** Stroud, P. (Los Alamos National Lab., NM, USA). *Laser and Particle Beams;* **4**: 261-273(May 1986).

A key issue in the design of an HIF reactor cavity is the transport of the heavy ion beam from final focusing, across the cavity, to the target. Previous estimates have indicated that streaming instabilities will disrupt the beam transport for a background chamber gas pressure of 10^{-4} to 10^{-1} torr. The most attractive liquid lithium first wall reactor cavity designs produce a background gas density in just this pressure range. A detailed analysis of the streaming instabilities has now demonstrated that the beam can be transported through this background. The important factor that had been neglected is that a mode with a given wave number will grow for only a small fraction of the transport time, due to the changing beam and electron densities during transport. This analysis opens wide an attractive window for reactor cavity design.

7023 **Spherically symmetric high-velocity plasma expansions into background gases.** Tai-Ho Tan; Borovsky, J.E. (Los Alamos National Lab., NM, USA). *Journal of Plasma Physics;* **35**: No. 2, 239-256(Apr 1986).

Spherically symmetric plasmas with high expansion velocities have been produced by irradiating targets with eight beams from the Helios CO_2 laser in the presence of gases at various pressures. Attention was given to the properties of the target-emitted ions in order to obtain information about the ion acceleration mechanisms in plasma expansions. Photo-ionization of the ambient gases by the soft X-ray emission from the laser-irradiated targets produced background plasmas, permitting plasma counterstreaming experiments to be performed in spherical geometry. Successful laser-target coupling in the presence of background gases is obtained, modification of the ion acceleration in accordance with isothermal-expansion models is observed, and an absence of collective coupling between collisionless counterstreaming plasmas is found.

7024 **An expert system to control a fusion energy experiment.** Johnson, R.R.; Canales, T.; Lager, D. (Lawrence Livermore National Labs., Livermore, CA). pp 1170-1175 of Proceedings of the 1986 American control conference. Piscataway, NJ; IEEE Service Center (1986). (CONF-860638—Vol.1).

From American control conference; Seattle, WA, USA (18 Jun 1986).

This paper describes a system that automates neutral beam source conditioning. The system achieves this with artificial intelligence techniques by encoding the behavior of several experts as a set of if-then rules in an expert system. One of the functions of the expert system is to control an adaptive controller that, in turn, controls the neutral beam source. The architecture of the system is presented followed by a description of its performance.

7025 **All solid state high voltage power supply for neutral beam sources.** Praeg, W. (Argonne National Lab., IL, USA). pp vp of Fusion technology 1984. Vol. 2. Proceedings of the 13. symposium held at Varese, Italy on 24-28 September 1984. Oxford, England; Pergamon Press (1984). (EUR—9183-EN; CONF-840915—).

From 13. symposium on fusion technology; Varese, Italy (24 Sep 1984).

The conceptual design of a high frequency solid state, high power, high voltage, power system that reacts fast enough to be compatible with the requirements of a neutral beam source is presented. The system offers the potential of significant advantages over conventional power line frequency systems; such as high reliability, long life, relatively little maintenance requirements, compact size and modular design.

7026 **Magnetic divertor design for the compact reversed-field pinch reactor.** Bathke, C.G.; Miller, R.L.; Krakowski, R.A. (Los Alamos National Lab., NM, USA). pp vp of Fusion technology 1984. Vol. 2. Proceedings of the 13. symposium held at Varese, Italy on 24-28 September 1984. Oxford, England; Pergamon Press (1984). (EUR—9183-EN; CONF-840915—).

From 13. symposium on fusion technology; Varese, Italy (24 Sep 1984).

A recently completed design of a Compact Reversed-Field Pinch Reactor based on pumped-limiter impurity control is used to estimate for the first time the impact of magnetic divertors. A range of divertor options for the low-toroidal-field RFP is examined, and a design selection is made constrained by considerations of field ripple (magnetic islands), blanket displacement, recirculating power, cost, heat flux, and access. Design choices based on diversion of

minority (toroidal) field lead to a preference for (poloidally) symmetric or bundle divertor geometries. Coupling of magnetics and scrapeoff models with the above-mentioned constraints yields design points for both divertor approaches.

7027 **Design and fabrication of a beryllium limiter for ISX-B.** Edmonds, P.H.; Watson, R.D.; Smith, M.F. (Oak Ridge National Lab., TN, USA; Sandia National Labs., Albuquerque, NM, USA). pp vp of Fusion technology 1984. Vol. 2. Proceedings of the 13. symposium held at Varese, Italy on 24-28 September 1984. Oxford, England; Pergamon Press (1984). (EUR—9183-EN; CONF-840915—). Contract AC05-84OR21400;AC04-76DP00789.

From 13. symposium on fusion technology; Varese, Italy (24 Sep 1984).

A movable, temperature-controlled, beryllium rail limiter has been used in the Impurity Study Experiment (ISX-B) tokamak. The limiter was designed for a surface temperature rise of 600°C for each tokamak shot. This rise corresponds to a heat flux to the limiter surface of approximately 2.1 to 2.4 kW/cm^2 for 0.3 s. The experimental test was expected to require a lifetime of approximately 3000 neutral beam-heated plasma discharges to meet the planned surface fluence of 10^{22} hydrogen ions per cm^2. A temperature control system was used to maintain the base-plate temperature of the limiter at about 200°C. The experimental results indicate that the beryllium limiter functions normally unless brought to melting point, when evaporated beryllium covers the liner walls, gettering the discharge. Under these conditions beryllium was the dominant impurity.

7028 **Thermomechanical testing of beryllium for the JET/ISX-B beryllium limiter experiment.** Watson, R.D.; Smith, M.F.; Whitley, J.B.; McDonald, J.M. (Sandia National Labs., Albuquerque, NM, USA). pp vp of Fusion technology 1984. Vol. 2. Proceedings of the 13. symposium held at Varese, Italy on 24-28 September 1984. Oxford, England; Pergamon Press (1984). (EUR—9183-EN; CONF-840915—). Contract AC04-76DP00789.

From 13. symposium on fusion technology; Varese, Italy (24 Sep 1984).

Materials testing of S-65-B beryllium has been conducted in support of the beryllium limiter experiment on the ISX-B tokamak. The S-65-B grade of hot-pressed beryllium was chosen over S-200-E because of its superior strength and ductility at elevated temperatures. The testing has included measurement of tensile and yield strength, ductility, Young's Modulus, thermal conductivity, and specific heat from 50°C to 700°C. Thermal fatigue testing of a 2.5 cm beryllium cube was conducted using an electron beam to apply a heat flux of 2.5 kw/cm^2 for 0.3 second pulses for 1500 cycles. Results from the tests are compared to elastic-plastic finite element stress calculations. The testing indicates that the ISX-B beryllium limiter should survive the tokamak environment without serious structural failure, although some surface cracking is expected to occur.

99 GENERAL AND MISCELLANEOUS

7029 **(DOE/ER—0335) Program solicitation: Closing date, January 22, 1988.** (USDOE Office of Energy Research, Washington, DC). 1987. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002269/JAW.

DOE invites small business firms to submit proposals in this sixth annual solicitation for the Small Business Innovation Research (SBIR) program. Firms with strong research capabilities in science or engineering in any of the topic areas described are encouraged to participate. DOE will support high-quality research or research and development (R and D) on advanced concepts concerning important energy related scientific or engineering problems and opportunities that could lead to significant public benefit if the research is successful. Objectives of this program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting Federal R and D needs, increasing the commercial application of DOE-supported research results, and improving the return on investment from Federally funded research for economic and social benefits to the Nation.

7030 **(DOE/ER—0336) Abstracts of Phase 1 awards, [fiscal year] 1987.** (USDOE Office of Energy Research, Washington, DC). 1987. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002270/JAW.

Contained in this booklet are abstracts of the Phase I awards made in Fiscal Year 1987 under the Small Business Innovation Research (SBIR) program in the Department of Energy (DOE). The program is designed for implementation in a three-phase process, with Phase I determining the scientific or technical merit and feasibility of ideas proposed for investigation. The period of performance in this initial phase is relatively brief, typically about 6 months, and the awards are limited to $50,000. Phase II is the principal research or research and development effort, and the awards are as high as $500,000 for work to be performed in periods of up to 2 years. Phase III is the commercial application. The 111 Phase I projects described were selected in a highly competitive process from a total of 942 proposals received in response to the 1987 Solicitation. They cover the fields of chemistry, materials, control systems, plant natural products, instrumentation, nuclear medicine, health and environmental effects, high energy physics, particle accelerators, nuclear physics, plasma diagnostics and confinement, fusion energy systems, robotics and remote systems, nuclear reactors, space nuclear power, fuel cycle, decontamination/decommissioning, commputers in nuclear plants, coal, enhanced oil recovery/tar sands, fossil energy, photovoltaics, solar thermal, ceramics for heat engines, and industrial separation, conversion and recovery processes. (DLC)

7031 **(DOE/MA—0288-3) Listing of Awardee Names: Inactive awards as of October 15, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 15 Oct 1987. 455p. NTIS, PC A20/MF A01; 1; GPO Dep. Order Number DE88001539/JAW.

This is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Inactive is defined as the completion date of the award is earlier (in the past) than the date of the issuance of the listing.

7032 **(K/DSRD—1) Turbine engine supportability study for Army Aviation Systems Command (AVSCOM).** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Oct 1987. Contract AC05-84OT21400. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002339/JAW.

This study attempts to assess the ability of the Army to support its gas turbine engine fleet which powers the US Army helicopter fleet. This task was composed of three elements: assessing the capabilities of commercial available sources, isolating the cost drivers, and investigating the entire spectrum of required support at all levels of maintenance. The study team was charged with making recommendations that would improve the effectiveness of logistic support while enhancing the mission readiness. The study centered on an intensive top-down examination of four options that exist within the worldwide gas turbine engine logistics arena. Those options are total contractor support, total in-house support, existing system, where the Army would utilize a mix of commercial contractors and government resources, and an enhanced current system, the recommended option of the study team, which utilizes a dual strategy for continued modernization, that is, increased reliance on the private sector in selected areas, as well as enhancements to the Army's existing systems.

7033 **(LA—11115-MS) General purpose force doctrine.** Weltman, J.J. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 14p. (CNSS/Papers—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002227/JAW.

In contemporary American strategic parlance, the general purpose forces have come to mean those forces intended for conflict situations other than nuclear war with the Soviet Union. As with all military forces, the general purpose forces are powerfully determined by prevailing conceptions of the problems they must meet and by institutional biases as to the proper way to deal with

those problems. This paper deals with the strategic problems these forces are intended to meet, the various and often conflicting doctrines and organizational structures which have been generated in order to meet those problems, and the factors which will influence general purpose doctrine and structure in the future. This paper does not attempt to prescribe technological solutions to the needs of the general purpose forces. Rather, it attempts to display the doctrinal and institutional context within which new technologies must operate, and which will largely determine whether these technologies are accepted into the force structure or not.

7034 **(TVA/ONRED/LER—87/21) Archaeological site stabilization in the Tennessee River Valley: Phase 3, Research Paper No. 7, Tennessee Valley Authority Publications in Anthropology No. 49.** Fay, P.M. (Tennessee Valley Authority, Norris (USA). Div. of Land and Economic Resources). 1987. 125p. NTIS, PC A06/MF A01. Order Number DE88900181/JAW.

Destruction of archaeological properties within the Tennessee River system, particularly along its main stem, has been a problem almost since TVA was established. In an attempt to stop the loss of massive portions of our cultural resources, the TVA contracted in 1983 to establish a program of site stabilization using experimental techniques. This report is the first installation of observations on the site protection measures placed during 1983. This report also contains pertinent observations on preserved sites not within TVA holdings. 20 refs., 25 figs.

9901 Management

7035 **(CNEA-NT—28/86) Report 1984/1985 Centro Atomico Bariloche.** (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). Sep 1986. 168p. (In Spanish). NTIS (US Sales Only), PC A08/MF A01 - Comision Nacional de Energia Atomica, Buenos Aires (AR). Order Number DE88700584/JAW.

A summary of the activities performed by the Bariloche Atomic Center during the period 1984-1985 is presented. These activities are: Basic Research, with its divisions: Low Temperatures, Atomic Collisions, Metals, Neutrons and Reactors; Magnetic Resonance; Theory, (includes Elementary Particles, Solid Theory, Relativity, Gravitation and Unified Theories); Applied Research, with its divisions: Development; Ceramics and Industrial Carbons; Metallurgy, and finally the Division of Nuclear Engineering, with its sections: Thermohydraulics; Computational Mechanics; Radioprotection; Reactors' Control; RA6 Reactor. Publications during this period, are also included. (M.E.L.).

7036 **(DOE/NV/10327—34) Affirmative Action Plan, October 1987 through September 1988.** (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Oct 1987. Contract AC08-84NV10327. 228p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88002190/JAW.

This report documents Reynolds Electrical and Engineering Co., Inc., analysis of all major job groups with explanations if minorities and females are underutilized in any one or more job group. Goals and timetables have been developed and good faith efforts are directed to correct any deficiencies. In addition, Affirmative Action Plans for the handicapped, Vietnam Era Veterans, and Disabled Veterans are included which set forth policies, practices, and procedures in accordance with Department of Labor regulations.

7037 **(RISO-R—547) Metallurgy Department progress report for the period 1 January to 31 December 1986.** Schroeder Pedersen, A.; Bilde-Soerensen, J.B. (eds.). (Risoe National Lab., Roskilde (Denmark)). Apr 1987. 96p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750348/JAW.

The activities of the Metallurgy Department at Risoe during 1986 are described. The work is presented in four chapters: General Materials Research, Technology and Materials Development, Chemical and Electrochemical Energy Research and Development, and Fuel Elements. A survey is given of the Department's participation in international collaboration and of its activities within education and training. A list (with abstracts) of publications and lectures by the staff during 1986 is included. (editors).

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 6505

7038 **(AD-A—184131/1/XAB) Interactive computer-graphics network monitor for a tactical communications network. Master's thesis.** Griggs, L.W. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1987. 89p. (NPS—52-87-035). NTIS, PC A05/MF A01.

In order to apply modern networking technology, either circuit- or packet-switched, to tactical communications networks, network designers must develop (1) robust link-level protocols to handle broadcast media and node mobility, and (2) distributed, adaptive routing protocols to handle the rapid reconfigurations required by node mobility and mortality. In addition, from the network manager's point of view, combat imposes electronic order of battle constraints that can affect network performance and limit the available network configurations. Optimizing message throughput under such design and operational constraints is extremely difficult. Intended as an aid to both network designers and managers, this study describes a network monitor that uses modern high-speed graphics hardware and a responsive multi-window user interface to depict, in real time, the state of a packet- or circuit-switched tactical communications network. The network state is modeled as a set of overlays to an existing well-known tactical display format, namely that of Naval Tactical Data System (NTDS). In implementation, tactical and network displays are decoupled in order to allow the network monitor's use with other graphical information systems.

7039 **(AD-A—184246/7/XAB) Tight upper bound for the speed-up of parallel best-first branch-and-bound algorithms. Technical report.** Huang, S.R.; Davis, L.S. (Maryland Univ., College Park (USA). Center for Automation Research). May 1987. 26p. (CAR-TR—290). NTIS, PC A03/MF A01.

Most previous studies of the speedup of parallel branch-and-bound algorithms are based on the amount of work done in the parallel case and in the sequential case. Any evaluation of a parallel algorithm should include both the execution time and the synchronization delay. In this paper, a finite-population queueing model is used to capture the synchronization delay in parallel branch-and-bound algorithms and to quantitatively predict the behavior of their speedup. A program to solve the Traveling Salesman Problem was written on a BBN Butterfly multiprocessor to empirically demonstrate the credibility of this theoretical analysis. Finally, it is noted that similar analyses can be applied to evaluate parallel AI systems in which processes communicate through a shared global database.

7040 **(AD-A—184327/5/XAB) End-of-year report for parallel-vision algorithm design and implementation. Technical report, 15 January 1986-14 January 1987.** Kanade, T.; Webb, J.A. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Robotics Inst.). Jun 1987. 32p. (CMU-RI-TR—87-15). NTIS, PC A03/MF A01.

The parallel-vision algorithm design and implementation project was established to facilitate vision programming on parallel architectures, particularly low-level vision and robot vehicle-control algorithms on the Carnegie Mellon Warp machine. To this end, the author have (1) demonstrated the use of the Warp machine in several different algorithms; (2) developed a specialized programming language, called Apply, for low-level vision programming on parallel architectures in general, and Warp in particular; (3) used Warp as a research tool in vision, as opposed to using it only for research in parallel vision; and (4) developed a significant library of low-level vision programs for use on Warp.

7041 (AD-A—184330/9/XAB) Low-level vision on Warp and the apply programming model. Technical report. Hamey, L.G.; Webb, J.A.; Wu, I.C. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Robotics Inst.). Jul 1987. 22p. (CMU-RI-TR—87-17). NTIS, PC A02/MF A01.

In the course of implementing low-level (image to image) vision algorithms on Warp, the authors have understood the mapping of this class of algorithms well enough so that the programming of these algorithms is now a straightforward and stereotypical task. The partitioning method used is input partitioning, which provides an efficient, natural implementation of this class of algorithms. A special programming language call Apply was developed, which reduces the problem of writing the algorithm for this class of programs to the task of writing the function to be applied to a window around a single pixel. Apply provides a method for programming Warp in these applications that is easy, consistent, and efficient. Apply is application-specific, but machine independent, it is possible to implement versions of Apply that run efficiently on a wide variety of computers. Implementations are described of Apply on Warp, UNIX and the Hughes HBA, and implementation is sketched on bit-serial processor arrays and distributed-memory machines.

7042 (CONF-870677—10) Numerical experiments with a parallel conjugate gradient method. Oppe, T.C.; Kincaid, D.R. (Texas Univ., Austin (USA). Center for Numerical Analysis). Apr 1987. Contract AS05-81ER10954. 22p. (CNA—208). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002178/JAW.

From 6. IMACS international symposium on computer methods for partial differential equations; Bethlehem, PA, USA (23 Jun 1987).

A parallel version of the conjugate gradient method introduced by Seager is implemented using various Cray multitasking tools. The parallel algorithm is used to solve a model partial differential equation on the unit square for various mesh sizes. Speed-up factors are given, and the effects of bank conflicts are noted. 8 refs., 10 figs.

7043 (CONF-8704224—1) A parallel algorithm for the general LU-factorization. Kincaid, D.R.; Oppe, T.C. (Texas Univ., Austin (USA). Center for Numerical Analysis). Apr 1987. Contract AS05-81ER10954. 20p. (CNA—209). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002177/JAW.

From Advances in computational methods workshop; Dallas, TX, USA (13 Apr 1987).

An algorithm for computing in parallel the general LU-factorization of a matrix is presented. As special cases, one obtains the Doolittle, Crout, and Cholesky methods. The algorithm was implemented and tested on the Cray X-MP/48. 10 refs., 1 fig., 1 tab.

7044 (CONF-8706183—2) Parallel LU-factorization algorithms for dense matrices. Oppe, T.C.; Kincaid, D.R. (Texas Univ., Austin (USA). Center for Numerical Analysis). May 1987. Contract AS05-81ER10954. 25p. (CNA—213). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002179/JAW.

From ICS '87: international conference on supercomputing; Athens, Greece (8 Jun 1987).

Several serial and parallel algorithms for computing the LU-factorization of a dense matrix are investigated. Numerical experiments and programming considerations to reduce bank conflicts on the Cray X-MP4 parallel computer are presented. Speedup factors are given for the parallel algorithms. 15 refs., 6 tabs.

7045 (DOE/ER/10954—T1) Adaptive iterative algorithms for large sparse linear systems. Mai, Tsun-zee. (Texas Univ., Austin (USA). Center for Numerical Analysis). Aug 1986. Contract AS05-81ER10954. 140p. (CNA—203). NTIS, PC A07. Order Number DE88002181/JAW.

The dissertation is concerned with the use of iterative algorithms to obtain numerical solutions of large systems of linear algebraic equations with sparse matrices. Such systems often arise in the numerical solution of partial differential equations by finite difference methods and by finite element methods. The emphasis is on the use of adaptive schemes for automatically determining parameters associated with various basic iterative methods and acceleration procedures. These parameters are needed in order that the convergence of the algorithms will be satisfactory. Methods designed for nonsymmetric as well as symmetric problems will be considered. 49 refs., 48 figs., 25 tabs.

7046 (FNAL-TM—1477) VTI: VME/CIPRICO Interface routines. Alleva, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 4 Sep 1987. Contract AC02-76CH03000. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002658/JAW.

This document details the VME/CIPRICO Interface routines (VII). These routines where designed to allow programs written in PILS running on a MVME 101 under Valet-plus to control a CIPRICO tape controller. The routines fall into two general types. The low level routines, such as vti-make-pb, create the data structures used by the CIPRICO as well as manipulate the CIPRICO's control registers. The high level routines, such as vti-rewind, use the lower level routines to carry out complete functions on tape drives. Most tape operations are implemented except for ring buffer record routines. The creation of ring buffer record lists linked to parameter blocks is possible, but no high level routines are implemented to work with these lists. Memory utilization, parameter block creation and linking, polling and interrupts, status reporting, and the VTI routines are discussed. 2 refs.

7047 (FNAL-TM—1478) VFI: VME/FASTBUS Interface routines. Alleva, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 10 Sep 1987. Contract AC02-76CH03000. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002657/JAW.

This documents describes the VME/FASTBUS Interface routines (VFI). These routines where designed to enable programs written in PILS running on a MVME 101 under Valet-plus to control a VME/FASTBUS Interface. The routines fall into two general types, control and transaction. The control routines, such as vmec-reset, work directly with the interface's registers. These routines set up and monitor operations between VME and FASTBUS. The transaction routines, such as vfi-write-dat, use the control routines to carry out complete functions on FASTBUS. Most FASTBUS operations are implemented except for the compound routines and some low level routines. This document is divided into seven sections, the first is the introduction. The remaining sections detail the interface's registers, the structure of operation codes, polling and interrupts, status reporting, the control routines, and the transaction routines.

7048 (FNAL-TM—1492) SVI: Super-VIOR interface routines. Alleva, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 21 Oct 1987. Contract AC02-76CH03000. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002843/JAW.

This document describes a set of routines for a VME DMA module called the Super-VIOR. The Super-VIOR interface routines, also called the SVI routines, are written in PILS and run under a Valet-plus system. These routines enable a program to set up, execute, and monitor DMA operations. The Super-VIOR Interface Routines are written in PILS, a high level language similar to BASIC and Pascal which is powerful and fast enough for most applications. One of the most powerful features of the Valet/PILS system is the ability to set up exception vectors and exception handlers directly in a program. This feature is used to handle interrupts from the MC68450 (a 4 channel, 16 bit DMA controller) and the interface's front panel. This document is divided into ten sections, the first being the introduction. The remaining sections detail the interface registers, channel initiation, polling and interrupts, status reporting, front panel interrupts, the configuration routines, the operation control routines, the status reporting routines, and special comments on the MC68450.

7049 **(JINR—R-2-86-848) Computers in theoretical physics.** Gerdt, V.P.; Meshcheryakov, M.G.; Shirkov, D.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700516/JAW.

The paper reviews the usage of computer mathematics in theoretical and mathematical investigations. Recommendations are given on further development of the JINR Computer Center in accordance with the program of theoretical researches. 27 refs.; 2 figs.

7050 **(JINR—R-10-86-618) ROLSM program for the robust minimization of a quadratic functional which non-linearly depends on parameters.** Zlokazov, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700534/JAW.

A method and a program for the robust minimization of the functionals of the type $\Sigma w(x) \{y(x)-f(x, P)\}/sup 2/$ are described. These are mainly oriented to the analysis of regressions f(x, P), depending non-linearly on the parameters P. The robustness is achieved due to the recalculation of the weights w(x) at each iteration of the minimization process. 7 refs.; 3 figs.

7051 **(LA-UR—87-2967) Where does CBT [computer-based training] fit in, now that we know so much? A front end analysis study.** Andrews, A.E.; Trainor, M.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871165—1). NTIS, PC A02. Order Number DE88000508/JAW.

From 9. interservice/industry training systems conference; Washington, DC, USA (30 Nov 1987).

Computer-based training (CBT) has now been in existence for over two decades. It has been implemented in both the private sector and government organizations at an exponential rate. Nevertheless, many institutions, particularly educational institutions, have not yet introduced CBT. Our knowledge of what works and what does not, as well as hardware and software advances, has greatly increased in the past few years. This paper addresses many management considerations with respect to CBT. First, we consider the generic environment in which CBT might be used and then issues that affect costs and benefits, including lessons learned by the Cognitive Engineering Design and Research Team (CEDAR) of the Los Alamos National Laboratory in its assessments. The final section gives some "how-to" guidelines on increasing the probability of successfully introducing CBT into the training environment. The underlying theme of the paper is that management should be guided by what we now know about costs and benefits in its decisions regarding CBT and fight the lure of "high tech" glitter.

7052 **(LA-UR—87-3385) After ten years of metafiles: Where does the Computer Graphics Metafile fit?.** Reed, T.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-8709181—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001840/JAW.

From Workshop on the CGM in the real world; Gaithersburg, MD, USA (15 Sep 1987).

This paper discusses the need at Los Alamos National Laboratory for the Computer Graphics Metafile standard and supporting software. A brief history of metafile usage at Los Alamos is given. This is followed by an overview of our computing environment and a description of our computer graphics system. Issues we face in making the transition from our metafile to a system supporting the Computer Graphics Metafile and related graphics standards is then discussed. Our present graphics software was designed to address specific needs at Los Alamos. The transition to the Computer Graphics Metafile and other related standards can take place only when these needs are met, hopefully in the marketplace. 6 refs., 2 figs.

7053 **(LA-UR—87-3441) Improved input representation for enhancement of neural network performance.** Aldrich, C.H.; An, Z.G.; Lee, K.; Lee, Y.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-8710189—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001830/JAW.

From Workshop on complex adaptive system; Santa Fe, NM, USA (1 Oct 1987).

The performance of an associate memory network depends significantly on the representation of the data. For example, it has already been recognized that bipolar representation of neurons with -1 and +1 states out- perform neurons with on and off states of +1 and 0 respectively. This paper will show that a simple modification of the pattern vector to have zero bias will provide even more significant increase for the performance of an associative memory network. The higher order algorithm is used for the numerical simulation studies of this paper. To the lowest order this algorithm reduces to the Hopfield model for auto-associative memory and the bidirectional associative memory (BAM) for hetero-associative memory model respectively. 16 refs., 4 figs., 1 tabs.

7054 **(N—87-28325) Support architecture for reliable distributed computing systems. Interim technical report, 9 November 1983-3 December 1985.** (Georgia Inst. of Tech., Atlanta (USA)). Feb 1986. 70p. (NASA-CR—181272; NAS—1.26:181272). NTIS, PC A04/MF A01.

The Clouds kernel design was through several design phases and is nearly complete. The object manager, the process manager, the storage manager, the communications manager, and the actions manager are examined.

7055 **(ORNL—6417) Proceedings of the second international symposium on methodologies for intelligent systems: Colloquia program.** Ras, Z.W.; Emrich, M.L.; Jankowski, A.W. (eds.). (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 354p. (CONF-871043—). NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88001490/JAW.

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

The following topics for the Symposium were presented in the symposium: Approximate Reasoning; Expert Systems; Intelligent Databases; Knowledge Representation; Learning and Adaptive Systems; Logic for Artificial Intelligence; and Man-Machine Interaction. Thirty-three papers have been cataloged separately.

7056 (ORNL—6417, pp 3-12) **An intelligent supervisory system for a hot strip mill finisher.** Miyabe, Yutaka; Kawamura, Kazuhiko; Cantwell, J. (Vanderbilt Univ., Nashville, TN). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

This paper describes a prototype intelligent supervisory system for hot strip finishing mills in steel manufacturing. In the past, control systems for hot strip finishing mills have been developed and refined in response to the demands for greater dimensional accuracy of steel sheets. Individually developed conventional control systems have been well tuned and run cooperatively, but lack intelligent supervisory capabilities. Therefore, conventional control systems frequently require assistance from human experts when abnormalities occur. The prototype intelligent finishing mill supervisory system described in this paper incorporates an intelligent supervisor in its top level. It gathers information from critical areas and dynamically creates tasks to warn the operator and recover from the abnormalities. The system takes advantage of an emerging AI toolset in a parallel processing environment and couples symbolic and numeric computation in real time. The toolset allows the user to construct a hierarchy of Autonomous Communicating Objects (ACOs), each of which may have some intelligent supervisory function and communicate with each other.

7057 (ORNL—6417, pp 13-23) **An architecture for intelligent decision support systems.** Schell, G.P. (Univ. of Tulsa, OK). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Decision support systems deal with data and models to aid the process of decision making. These systems are useful for solving unstructured and semistructured problems. For such a system to be intelligent it must be able to infer what models are applicable to the problem at hand and retrieve data necessary for the models. The dilemma of choosing which model and data are appropriate for the problem is difficult itself. This paper addresses a structure for an intelligent decision support system that will allow it to process a range of problems without becoming so cumbersome as to prevent its practical use.

7058 (ORNL—6417, pp 25-38) **Building an intelligent software engineering environment.** Russell, L.; Bassman, M.J. (Computer Sciences Corp., Falls Church, VA). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Software engineering environments are large, complex systems which would benefit greatly from the addition of semantics. The resulting "intelligent" environments would support the interchange of data. The problem is how to structure the task of building such an environment. Four issues must be considered: ensuring complete and consistent data, identifying the process of defining semantics and establishing responsibility, the theoretical limitations, and the feasibility of the proposed approaches.

7059 (ORNL—6417, pp 41-48) **The heuristic search algorithm A*LP for logic programs.** Chen, Huo-yan. (Univ. of Illinois, Urbana). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

In Prolog, the standard computation rule always selects, in each step, the first subgoal in the current goal, and the standard search rule chooses the matching clause in the order of appearance in the program text. In fact, this standard control strategy is depth-first search strategy. So it may be inefficient. In order to raise efficiency, we can use heuristic search strategy. This paper applies the algorithm A*[1] with heuristic search to solving logic programs. We call it A*LP. The main problem in using algorithm A*LP for solving logic programs lies in determining the appropriate heuristic function. In this paper, for the specific problem domain of logic programs, we construct a heuristic function. Using the algorithm A*LP with this heuristic function, we can get the optimal solution for logic programs.

7060 (ORNL—6417, pp 49-60) **Extending deduction graphs for inferring and redundancy-checking function-free rules.** Yang, Chao-Chih. (North Texas State Univ., Denton). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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This paper extends deduction graphs (DG) to include function-free recursive rules for inferring rules and facts of a knowledge-base. After extension, DGs are also applied for checking redundancies in function-free recursive rules. This inferrencing mechanism does not use the inference rule of resolution which has been most frequently used in theorem proving and logic programming. In addition, a new systematic method is provided for redundancy-checking.

7061 (ORNL—6417, pp 61-70) **Propagation of failure experience for reduction of Prolog search space with theorem proving techniques.** Yoo, Seongjoon; Lim, Young-hwan; Oh, Gil-rok. (Electronics and Telecommunications Research Institute, Chung-Nam, Korea). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Standard Prolog has the problem of repeating search procedure uselessly for failed goal. In this paper, algorithms are developed for the efficient search of Prolog by reduction of the redundant procedure. The method is based on connection graph and some theorem proving techniques. It takes advantages of connection graph techniques in theorem proving mentioned by Kowalski and others, such as examining only relevant literals, using the connection relation (the results from preprocessing). Moreover, it eliminates the redundant search processing by subsumption test of a node in resolution tree with failed literals.

7062 (ORNL—6417, pp 71-75) **The "Rid-redundant" procedure in C-Prolog.** Chen, Huo-yan; Wah, B.W. (Univ. of Illinois, Urbana). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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C-Prolog can conveniently be used for logical inferences on knowledge bases. However, as similar to many search methods using backward chaining, a large number of redundant computation may be produced in recursive calls. To overcome this problem, we have designed the "rid-redundant" procedure to rid all redundant computations in running multi-recursive procedures. Experimental results obtained for C-Prolog on the Vax 11/780 computer show that there is an order of magnitude improvement in the running time and solvable problem size.

7063 (ORNL—6417, pp 79-88) **On the representation of isa hierarchies, exceptions, metaphors, and other 'anomalies'.** Balaban, M. (State Univ. of New York, Albany). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

We develop a first order theory of object oriented paradigms, that can represent "isa" hierarchies with property inheritance, exceptions, metaphors and other "anomalies." The theory is based on a "like" relationship between objects, and uses the terms of the logic to represent optional properties (i.e., ones that can be overridden). We claim that the common sense reasoning that is, usually, associated with object-oriented formalisms, should be handled by the reasoning procedures, and be separated from the representation language itself. We hope that these ideas would trigger a new generation of first-order-logic based, object-oriented systems.

7064 (ORNL—6417, pp 89-97) **Conformity proof.** Wojcik, Z.M. (Wichita State Univ., KS). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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The basic condition of representing events is presented in the paper. It states the necessary and sufficient condition upon which an event, image or sample is representable correctly in a computer system. The necessary condition is based on the request to guarantee termination of the process of representation of an event within a finite period of time. The proof of the sufficient condition utilizes the underlying property of the group theory applied in physics: that a description of a given physical phenomenon is invariant in the space of observation. Examples are presented of applications of the basic condition in pattern recognition, in the design of image processing and of shape coding algorithms.

7065 (ORNL—6417, pp 99-111) **On reduction of knowledge representation.** Ziarko, W. (Univ. of Regina, Canada). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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A technique based on the probabilistic rough set concept for knowledge representation reduction is reviewed. It is assumed that knowledge about entities is represented by feature vectors, a technique which has been used in many applications such as medical data representation, decision tables, and speech recognition. One of the fundamental problems is the reduction of the representation by extracting the essential or dominant features of the knowledge to be

represented. The technique discussed in this paper has been implemented as a data analysis system ANLYST on a microprocessor. Some numerical examples of the application of this system are also presented.

7066 (ORNL—6417, pp 113-119) **A new technique of fuzzy inference and new generation expert system.** Faqiang, Zhou; JiZheng, Sun; Xianghe, Zhou. (China Institute of Mining and Technology, Jiangsu; A.I. Wuhan Univ., Peoples Republic of China). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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This report details problems involved in the application of fuzzy inference in future generations of expert systems. For this reason, the architecture of the new generation export system (NGESM) design is discussed first. Utilizing the characteristics of NGESM (rapid processing of large-scaled knowledge), the technique of Limited Fuzzy Semantic Inference (LFSI) has been devised. This technique includes a more powerful knowledge representational model; limited fuzzy production relation, and a high speed fuzzy semantic inference method in which relation composition and general mathematics operation are necessary. The fuzzy inference algorithm of Fuzzy-NGESM (F-NGESM) is given. (FI)

7067 (ORNL—6417, pp 123-131) **A one-touch-dial system.** Tobe, Miharu; Itoh, Haruhisa; Sakai, Youichi. (NTT Electrical Communications Labs., Tokyo, Japan). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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The intelligent one-touch-dial system for improving convenience on telephone communications is proposed in this paper. At each telephone call, an intelligent telephone terminal with a display unit having touch sensor gets and stores subscriber's information such as partner's name and address. Then it edits them automatically and makes lists from the call history. These lists are displayed on and utilized for one touch dialing. The call history analyzation indicates that a telephone user can call more than 70% of all calls by one touch dialing with the list arranged in this system.

7068 (ORNL—6417, pp 133-144) **Concept formation by psychologically plausible classification.** Hadzikadic, M.; Yun, D.Y.Y. (Southern Methodist Univ., Dallas, TX). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Classification (learning by observation) is one of the basic mechanisms which allow humans to learn as well as to deal efficiently with the complexity of the real world. To be able to react appropriately to changes in the environment, people build a mental model of the real world which allows them to infer the corresponding response (action) and the resulting state of the real world. The inductive process of classification represents a mapping between a set of events from the real world and a mental representative of it, used by the cognitive systems to reduce the complexity of the outside world. The mental model helps the classification process to reduce the hypotheses formation space by defining the goal and context of the classification as well as making available the information retrieved by the spreading activation process. It is the recognition of the importance of the discussed assumptions, the manner of their implementation in the classification algorithm, as well as the suggested computational model of cognitive systems that represent the foundations of the approach presented in this paper.

7069 (ORNL—6417, pp 145-155) **Algebraic and logical description of functional and multivalued dependencies.** Rauszer, C. (Univ. of Kentucky, Lexington). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Functional and multivalued dependencies are expressed in terms of special equivalence relations, called indiscernibility relations. Subsequently, an algebra of indiscernibility relations of a given relational database is introduced and examined. It is shown that a dependency holds in a database if and only if a corresponding algebraic formula is equal to the greatest element in the algebra. In addition, a formal deductive system, called D-logic is defined. This system corresponds to a fragment of non-classical logic. An equivalence theorem showing that D-logic describes, in an adequate way, properties of functional and multivalued dependencies is stated. Theorems proving correctness of algorithms for constructing covers for dependencies are presented. D-logic and D-lattices are instrumental in proving several properties of dependencies. Examples showing that these techniques are valuable in proving theorems about dependencies are given.

7070 (ORNL—6417, pp 159-172) **Expansion of knowledge via consolidation of knowledge.** Reisman, A. (Case Western Reserve Univ., Cleveland, OH). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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This paper addresses the need to consolidate knowledge while expanding it by creating taxonomies and/or generalized formulations. A number of ways to achieve that end are delineated and embedded in a suggested taxonomy of taxonomies. Selected works from both the "hard" and the management sciences are summarized to demonstrate the variety of knowledge consolidating role models and to test the effectiveness of the Taxonomy of Taxonomies.

7071 (ORNL—6417, pp 173-178) **Template knowledge as a tool in expert system applications.** Hall, L.O. (Univ. of South Florida, Tampa). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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An effective use of variables in the knowledge base of an expert system is discussed. Implication relations with variables may be seen as knowledge templates. These knowledge templates provide the knowledge engineer with more expressive power in capturing an experts knowledge. Their use and importance in a system which can symbolic solve mathematical word problems is shown. This is a typical application, which points up some of their power and possible pitfalls. The template knowledge base is implemented in two different representations, one of which belongs to a commercially available expert system tool. The implications of template knowledge and the best methods to make use of it are then further discussed.

7072 (ORNL—6417, pp 179-189) **The generalized concept (G-C) formalism: An object-oriented, logic framework for knowledge representation.** Balaban, M. (State Univ. of New York, Albany). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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We present an object-oriented logic framework, entitled "The Generalized-Concept (G-C)" model, and provide a design methodology and a set of frame-like abbreviations for it. The formalism is descriptively powerful and can account for all regular uses of frames, including more problematic features, like handling exceptions and representing metaphors. Yet, it is a traditional logic framework, with the traditional Tarskian semantics. It can be thought of as the dual of the logic based semantic networks of the late 70's. The multiple object-oriented, logic character makes the G-C formalism appropriate for both theoretical and practical research in object-oriented representation. In particular, it may provide a start point for building rigorous, object-oriented, procedural systems. This might be an important step towards closing the gap between application and theory in AI systems.

7073 (ORNL—6417, pp 191-199) **Semantic decidability in knowledge data bases.** Wojcik, Z.M. (Wichita State Univ., KS). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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The paper presents a methodology of making data bases independent of possible positions of observer in the space of observation. This methodology provides semantic decidability of symbols representing real situations and events. The semantic decidability means the ability of checking, even by an artificial intelligence system, the consistency between an event and a set of symbols representing the event. Basic concepts of formal languages, group theory (used in physics) and syntactic decidability are utilized. Some consequences of the semantic decidability are discussed, e.g., the paradox of liar, syntactic undecidability of natural numbers and methodology for construction of recognition algorithms. It is suggested that the group theory should be imposed on mathematical models of any real structure.

7074 (ORNL—6417, pp 203-213) **KDL: A hyper-semantic data model specification language.** Potter, W.D.; Trueblood, R.P.; Eastman, C.M.; Matthews, M.M. (Univ. of Georgia, Athens; Univ. of South Carolina, Columbia). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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The paper describes a schema specification language developed for the Knowledge/Data Model. The Knowledge/Data Model captures both knowledge semantics, as specified in Knowledge Based Systems, and data semantics, as represented by Semantic Data Models. The Knowledge/Data Model can be thought of as an instance of a new class of models, called hyper-semantic data models, which facilitate the incorporation of knowledge in the form of heuristics, uncertainty, constraints and other Artificial Intelligence concepts, together with object-oriented concepts found in Semantic Data Models. The unified knowledge/data modeling features are provided via the constructs of the Knowledge/Data Language.

7075 (ORNL—6417, pp 215-226) **Partial order based characterization and synthesis of multi-agent cooperative plans.** Bahler, D. (North Carolina State Univ., Raleigh). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Multi-agent plans are those by which multiple cooperating agents may achieve a goal from an initial situation, using a grammar which provides the means of transforming one situation into another. This report describes a means of characterizing multi-agent plans as a strict partial ordering defined over a multiset of operators, where the ordering relation indicates necessary precedence in time, and offers a means of formalizing the notion of correctness of a nonlinear plan. Since the ordering is partial rather than total, it is suitable for execution by multiple agents (which may be processors, robot controllers, effectors, or the like) if such are available in the execution environment. Also described is a technique for synthesizing a plan in which events incomparable in the ordering will not interfere with one another. This technique creates plans which are probably valid solutions of their input problems.

7076 (ORNL—6417, pp 227-238) **A stochastic computing architecture for multi-domain problem solving.** Fields, C.; Dietrich, E. (Colorado State Univ., Fort Collins; New Mexico State Univ., Las Cruces). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Human multi-domain problem solving is often wanton in the sense that inferences are made that violate antecedent assessments of relevance. Explaining wanton inference requires postulating a mechanism that is independent of both the content and the data type of the states connected. We propose stochastic control as such a mechanism, and describe a class of machines called transition virtual machines (TVMs) that execute stochastic control. We describe one such machine in detail. We consider the relation between TVMs and parallel distributed processing (PDP) machines, and show that TVMs can be thought of as PDP machines with plastic, i.e., time-varying connections.

7077 (ORNL—6417, pp 239-247) **A meta-level architecture for planning and controlling problem-solving process in expert system.** Aidong, Zhang; Jiwen, Guan. (Jilin Univ., Changchun, China). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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The paper presents a meta-level architecture for planning and controlling problem-solving process in expert system. The planning means to carry on a problem decomposition and transform the problem into a problem-solving plan described by a problem-solving plan description language (PPDL). And the controlling means to determine which knowledge sources in objective knowledge base are relevant to current task and choose one to apply (matching and conflict resolution). The system uses two types of metaknowledge, called strategy-knowledge and control-knowledge. The architecture is composed of four layered parts: (1) a high-controller guides the invocation of strategy-knowledge at top-level; and (2) a planner constructs a problem solving plan by using the strategy-knowledge; and (3) a PPDL interpreter manages the problem-solving process; and (4) a low-controller guides the invocation of objective knowledge sources. In addition, at the stage (3) and object-level, the system may propose new subtasks so that the planner can be reinvoked to adjust the problem-solving plan dynamically.

7078 (ORNL—6417, pp 251-260) **A mathematical theory of heuristic information.** Tzeng, Chun-Hung. (Ball State Univ., Muncie, IN). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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This paper briefly presents a mathematical model of heuristic information in game-tree searches and corresponding decision-makings. The notion of heuristic information is formulated as events in a probability space. A heuristic game-tree search, consisting of node evaluation and decision making, is formalized into three components: a searching process for heuristic information, a node-strength evaluating process, and a decision-making process. The searching process always accumulates more heuristic information at a deeper search. The estimate of a node strength based on heuristic information is the conditional expectation of the corresponding random variable and becomes more precise if based on more precise information. Due to this monotonicity of node-strength estimates, the quality of the decision making can be improved if it is based on more precise information.

7079 (ORNL—6417, pp 261-270) **B-fuzzy sets.** Lewis, J.W. (Martin Marietta Labs., Baltimore, MD). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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B-spline techniques provide a convenient basis for defining and computing characteristic functions for fuzzy sets. First, the characteristic function of a fuzzy set can be defined and visualized through the B-spline Bezier polygon. Because the shape of the spline function in any interval is determined by a k-neighborhood of its polygon, the polygon is a convenient tool for manipulating such functions and analyzing the characteristics of the resulting B-fuzzy sets. Second, these B-fuzzy set operations, while not identical to the usual definitions, do preserve properties such as non-negativity, monotonicity, and convexity in the results. Third, the B-fuzzy operations are closed, i.e., if the original characteristic functions are B-splines of a particular class, the resulting characteristic functions are B-splines in the same class. This fact greatly simplifies computations on fuzzy sets. Finally, the locality property of B-spline enables the symbolic computation of local endorsements through which a user can query the inference process leading to a particular part of the characteristic function.

7080 (ORNL—6417, pp 271-281) **NPN [negative-positive-neutral] relations and cognitive map development.** Zhang, Wen-Ran; Bezdek, J.C.; Pettus, R.O. (Univ. of North Carolina, Charlotte; Boeing Electronics Co.; Univ of South Carolina, Columbia). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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The notions of NPN (Negative-Positive-Neutral) crisp relations, NPN fuzzy relations, and Heuristic Transitive Closures (HTCs) are proposed, which are extensions of 2-valued crisp binary relations and the classical fuzzy relations. The extensions are made by: (1) extending 2-valued binary relations to 3-valued NPN binary relations by using -1 (Negative), 0 (neutral), 1 (Positive), and the 3-valued logic; (2) extending classical fuzzy relations from the interval [0,1] to the interval [-1,1]; and (3) incorporating the heuristics derived form the 3-valued logic into transitive closure (TC) computations, which leads to the definition of heuristic transitive closure (HTC). An algorithm is constructed for HTC computation. An application of the proposed model is demonstrated in cognitive map development in the realm of decision supporting. Research results show that, in the selected application domain, HTCs possess more representational and inferential power, while TCs might be misleading.

7081 (ORNL—6417, pp 285-296) **A case study in expert system development.** Plant, R.T.; Shave, M.J.R.; Moralee, D.S. (Univ. of Liverpool, England). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Developers of expert systems often complain that the area lacks a sound methodology through which systems can be built, and that they are forced to treat each system as a one off, to be constructed using ad hoc techniques. This view holds even though several design methods have been suggested within the literature [Hayes-Roth, et al.], [Davis], [Weiss, et al.]. A possible reason for this in our view is that the main goal of these methods is to produce an implementation as quickly as possible from the elicited knowledge regardless of consistency, completeness etc., these parameters being considered post implementation. This approach, which is more akin to prototyping than software engineering, is not necessarily the best. This paper aims to introduce a new design methodology where the advantage of using several intermediate representations is made to refine the knowledge base. By breaking down the process in this way the most appropriate knowledge representations for the domain can be selected, which when combined with a formal specification of the domain knowledge produces a concrete specification from which an implementation can be made. This paper presents a case study showing the theory in practice.

7082 (ORNL—6417, pp 297-308) **Honeywell's combat information fusion testbed.** Bennett, B.H.; Little, R.K. (Honeywell, Inc., Minneapolis, MN). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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Honeywell's Combat Information Fusion Testbed (CIFT) has been developed to provide the hardware and software environment that can support development of tools powerful enough to assist intelligence analysts in correlating information from widely disparate sources. The current testbed capabilities were chosen for the contexts of handling an airborne moving target indication (MTI) radar, a standoff signal intelligence (SIGINT) system, and an unmanned aerial vehicle (UAV) with a television camera payload. This correlation capability is fundamental for data fusion. By integrating Honeywell's proprietary real-time backboard architecture (RTBA) with the proprietary spatial-temporal reasoning technique called topological representation (TR) the testbed has been able to perform the data association task.

7083 (ORNL—6417, pp 309-320) **A prototype of an intelligent operating system consultant.** Bykat, A. (Univ. of Tennessee, Chattanooga). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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In this paper we describe a prototype of our research project OSCAT [Bykat, 1986]. The ultimate goal of OSCAT is to test the proposed theories necessary to describe the functions of a knowledge based system playing a role of an intelligent Operating System Consultant and Teacher in a training environment. The pragmatic aims of OSCAT are to create an interface to an operating system which offers intelligent features for control and interrogation of the underlying system, as well as facilities for effective training of personnel in the use of the system's resources. To perform its consulting and training functions OSCAT communicates in natural language and uses models of the user's knowledge, of the conversation, and of the domain. OSCAT's environment consists of the components specified in Fig. 1. The prototype is implemented in Prolog for VM/CMS system operating on an IBM 4381 minicomputer. However, special emphasis is placed on synthesis of the theory and methodology independent of a particular operating system and thus independent of particular hardware.

7084 (ORNL—6417, pp 321-331) **A fuzzy knowledge-based system shell.** Leung, K.S.; Lam, W. (Chinese Univ. of Hong Kong, Shatin). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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A knowledge-based system shell called SYSTEM Z-1 which is based on an original approach using fuzzy reasoning and linguistic techniques is presented. The prototype system developed consists of a parser, three knowledge base management modules, an independent knowledge base for storing fuzzy rules and facts, an inference engine based on fuzzy logic, and a linguistic approximation routine. This system can handle inexact reasoning and has a natural language interface with a limited vocabulary. Multiple fuzzy propositions are also allowed in the rules of the system. The overall architecture and the individual modules of the system are described. Its implementation environment are briefly discussed.

7085 (ORNL—6417, pp 335-338) **Knowledge-based ADP project cost estimating.** Arrowood, L.F.; Albright, K.; Emrich, M.L.; Sadlowe, A.R. (Oak Ridge National Lab., TN). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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A knowledge-based system, called ADP-Estimator, is being developed to perform ADP project cost estimating. Designed to retain crucial expertise held by experienced project leaders, this system allows inexperienced project leaders to interactively generate cost estimates. Initially, project leaders indicate any constraints (e.g., personnel levels, equipment, facilities, etc.) placed upon a project. The system uses these to identify resources and procedures required for project completion. If no solution can be generated which meets these constraints, the user is instructed to modify one or more constraints and try again. Partial estimates are saved to reduce blind backtracking. Estimates and their justifications can be saved, to be recalled and modified when given new information.

7086 (ORNL—6417, pp 339-347) **Pattern classification as a rule-guided expert system.** Wong, S.K.M.; Wan, S.J. (Univ. of Regina, Saskatchewan, Canada; Wuhan Technical Univ. of Surveying and Mapping, China). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

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One of the main objectives in the traditional decision-theoretic approach in pattern recognition is to look for suitable discriminant functions. However, most of these functions provide little insight into the dependence of each pattern class on the feature values. When the components of the feature vectors are discrete, the recognition problem can be viewed as a ruleguided expert system. In this paper, we suggest an alternative approach to pattern recognition by inferring generalized decision rules from a set of samples. The main advantages of the proposed method are that the decision rules are generalized and superfluous or dominant attributes can be easily identified. Our method not only provides an effective classifier for pattern recognition but more importantly it also enhances our understanding of the relationship between each pattern class and the feature values.

7087 (ORNL—6417, pp 349-357) **An expert system for assisting in air cargo allocation.** Nygard, K.E.; Juell, P.; Downes, T. (North Dakota State Univ., Fargo; AT & T Corp., Naperville, IL). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

An expert system was developed as an integral part of a decision support system for allocating Air Force cargo in the continental United States. The expert system works in concert with a mathematical model and human-oriented decision support tools. The symbiosis results in a system which quickly provides high quality allocations on a microcomputer. Software tools which facilitated the integration include a compiler which translates forward chaining production system rules to Pascal and a large model Pascal compiler which allows overlays and program chaining.

7088 (ORNL—6417, pp 359-366) **An expert system for Pascal programmers written in Pascal.** Zhao, Y.; Hogstad, R.; Miller, R. (Southwestern Oklahoma State Univ., Weatherford). Sep 1987. NTIS, PC A16/MF A01. Order Number DE88001490/JAW. (CONF-871043—).

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

An expert system is developed for Pascal programmers. It is a rule-based expert system. A rule is in the form of if P1 and P2 and ... and Pn then Q, where Pi are predicates and Q is an English sentence which gives the solution to the inquiry entered by a user. The system can accept rules from experts to propose answers for various problems that a user is seeking solutions for. Alternative rules can be entered with heuristic values. The system will try to confirm those predicates for the rules with highest heuristic value. Forward chaining as well as backward chaining are used in the inference engine of the system. Knowledge can be accumulated during the life time of the system and can be evaluated by experts. The knowledge that leads to better solution will have the higher priority of being used. In this sense the system has some learning ability. The system also has a natural language interface which enables the system to understand the question entered by users and to give solutions in English. The natural language interface uses a simplified case grammar. It has the capability to increase its vocabulary and to recognize synonyms. Applications other than Pascal programming are possible with the system. The system is currently used for, but not limited to, educational purposes.

7089 **(PB—87-225959/XAB) Efficient parallel algorithm for the connected-component problem and its implementation on the DPP84 (Delft Parallel Processor).** Peper, F. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1986. 19p. (REPT—86-41). NTIS, PC E03/MF A01.

This report describes an algorithm for determining the connected components of a simple undirected graph with n nodes using O(n) time and n processors. It requires a Shared Memory SIMD model permitting simultaneous reading from the same memory location by different processors (read conflicts). Its implementation on the DPP 84 (the Delft Parallel Processor) and related problems are described.

7090 **(PB—87-225975/XAB) State-of-the-art in parallel nonlinear optimization.** Lootsma, F.A.; Ragsdell, K.M. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1986. 38p. (REPT—86-44). NTIS, PC E03/MF A01.

This survey is concerned with variants of nonlinear optimization methods designed for implementation on parallel computers. First, the authors consider a variety of methods for unconstrained minimization. They consider a particular type of parallelism (simultaneous function and gradient evaluations) and concentrate on the main sources of inspiration: conjugate directions, homogeneous functions, variable-metric updates, and multi-dimensional searches. The computational process for solving small and medium-size constrained optimization problems is usually based on unconstrained optimization. This provides a straightforward opportunity for the introduction of parallelism. This survey, however, focuses on promising approaches for solving large, well-structured constrained problems: dualization of problems with separable objective and constraint functions, and decomposition of hierarchical problems with linking variables (typical for Benders' decomposition in the linear case). Finally, the authors outline the key issues in future computational studies of parallel nonlinear optimization algorithms.

7091 **(PB—87-226338/XAB) Data transport in Wang's partition method.** Michielse, P.H.; van der Vorst, H.A. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1986. 16p. (REPT—86-32). NTIS, PC E03/MF A01.

The partition method of Wang for tridiagonal equations is analyzed with respect to the amount of data transport between the processors of a parallel computer. The authors propose a modification that effectively leads to a considerable decrease in data transport. They also discuss the effects of the modification to a generalized version for banded systems, and, as a special case, the parallel solution of a bidiagonal system is considered.

7092 **(PB—87-227955/XAB) Discussion of some theoretical foundations of asynchronous parallel processes.** Nygard, M.; Stroemme, J.E. (Trondheim Univ. (Norway). Computing Centre). 31 Dec 1986. 19p. NTIS, PC E03/MF E03.

Also pub. as Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway) rept. no. STF—14-A86063.

The authors explore high-level parallel-processing mechanisms using concepts similar to those often used to describe the human mind. They discuss a system characteristic termed alertness, realized by a continuous kernel.

7093 **(PB—87-234738/XAB) Simulation of parallel algorithms on a distributed network. Technical report.** Schoone, A.A.; van Leeuwen, J. (Rijksuniversiteit Utrecht (Netherlands). Dept. of Computer Science). Jan 1986. 26p. (RUU-CS—86-1). NTIS, PC E03/MF A01.

The authors investigate the possibilities to ensure synchronization in a distributed network by enhancing the link-level protocol used for communication on the network links. It is shown that distributed (local) synchronization and link-level message control can be achieved by means of one protocol skeleton, that can be proved correct by the technique of system-wide invariants. The result is used to obtain a general protocol for the message-efficient simulation of (synchronous) parallel algorithms on (asynchronous) distributed networks that requires only one bit of extra information in every message for control purposes in the simplest case.

7094 **(PB—87-234951/XAB) Hierarchical parallel memory systems and multi-periodic skewing schemes. Technical report.** Tel, G.; Wijshoff, H.A.G. (Rijksuniversiteit Utrecht (Netherlands). Dept. of Computer Science). Aug 1985. 20p. (RUU-CS—85-24). NTIS, PC E03/MF A01.

The theory of skewing schemes deals with the problem of distributing data in parallel memories, in such a way that parallel computations can proceed efficiently. Until now, skewing schemes have been studied from the viewpoint of the BSP and ILLIAC IV architectures. Here, the authors are concerned with hierarchically organized parallel memory-systems, for which a new class of skewing schemes is introduced, namely the multi-periodic skewing schemes. The authors show that multi-periodic skewing schemes are an extension of both the periodic skewing schemes and the diamond schemes for traditional parallel memories. It is also shown that the schemes work out very well for many applications and, in particular, a bound on the minimum number of memory banks needed for certain applications is derived. Furthermore, multi-periodic skewing schemes can be represented at the cost of only a small amount of space, which makes them of practical interest.

7095 **(PB—87-235750/XAB) Complexity of finding uniform emulations on fixed graphs. Technical report.** Bodlaender, H.L. (Rijksuniversiteit Utrecht (Netherlands). Dept. of Computer Science). May 1985. 14p. (RUU-CS—85-14). NTIS, PC E03/MF A01.

Uniform emulations are a method to obtain efficient and structure-preserving simulations of large networks on smaller net-

works. The authors show that for every fixed graph H, that is connected (or strongly connected in the case of directed graphs) but not complete, the problem to decide whether another (strongly) connected graph G can be uniformly emulated on H is NP-complete.

7096 **(PB—87-235776/XAB) Emulations of processor networks with buses. Technical report.** Bodlaender, H.L. (Rijksuniversiteit Utrecht (Netherlands). Dept. of Computer Science). Aug 1985. 21p. (RUU-CS—85-20). NTIS, PC E03/MF A01.

Parallel algorithms are normally designed for execution on networks of N processors, with N depending on the size of the problem to be solved. In order that a parallel algorithm can be executed on a concrete, fixed-size network in practice, one can attempt to map (simulate) the unrestricted network on the smaller network. For networks that use direct connections (links) between pairs of processors, a suitable notion of simulation, termed emulation, was introduced by Fishburn and Finkel. The report extends the concept to the realistic case of networks that use buses, i.e. connections between arbitrary large sets of processors, as well. Several emulations of the spanning-bus hypercube and the dual-bus hypercube on smaller networks of the same type are given.

7097 **(PB—87-235792/XAB) Approximation algorithms for determining minimum cost emulations. Technical report.** Bodlaender, H.L. (Rijksuniversiteit Utrecht (Netherlands). Dept. of Computer Science). Mar 1985. 15p. (RUU-CS—85-10). NTIS, PC E03/MF A01.

Emulations are structure preserving simulations of large (processor-) networks on smaller networks. The notion of computation cost of an emulation is introduced. It is shown that every polynomial time-approximation algorithm for minimizing the computation cost of an emulation of a network G on a network H must have a worst case in which the resulting approximation differs by at least a factor 2 from the optimal solution (unless P=NP). Relations between approximation algorithms that minimize the computation cost of emulations and approximation algorithms for BANDWIDTH, CLIQUE and BALANCED COMPLETE BIPARTITE SUBGRAPH are given, which indicate that it will be hard (if not impossible) to find polynomial time-approximation algorithms that give good approximations of the minimum computation cost possible for emulations of a given graph G on a given graph H.

7098 **(SAND—87-2037) DOE data exchange format specification, mechanical products/drafting: Version 1.2.2: CADCAM-045.** (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01. Order Number DE88001923/JAW.

The Data Exchange Format (DEF) has been developed as part of a Department of Energy (DOE) effort to integrate the Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) activities throughout the Nuclear Weapons Complex (NWC). A primary objective of this effort is to provide a capability for the exchange of digital data between dissimilar CAD/CAM systems within the NWC. This specification is the result of a collective effort of the DOE Data Exchange Format Group charged with the task of defining a subset of the Initial Graphics Exchange Specification (IGES) to be used as the data exchange format for the mechanical products/drafting application.

7099 **(SAND—87-2652C) Object tracking in the 2D image plane.** Hush, D.R.; Donohoe, G.W. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-871162—2). NTIS, PC A02. Order Number DE88002111/JAW.

From 21. annual Asilomar conference on signals, systems, and computers; Pacific Grove, CA, USA (2 Nov 1987).

This paper presents a method for tracking multiple objects in a sequence of video images. The tracking is performed in the two-dimensional image plane. Estimates of each object's size, velocity, and location are updated at each iteration. Further, tracking is maintained for objects as they cross paths and as they disappear for brief periods of time due to occlusions. 10 refs., 4 figs.

7100 **(SOL—87-12) A Schur-complement method for sparse quadratic programming.** Gill, P.E.; Murray, W.; Saunders, M.A.; Wright, M.H. (Stanford Univ., CA (USA). Systems Optimization Lab.). Oct 1987. Contract FG03-87ER25030. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002520/JAW.

In applying active-set methods to sparse quadratic programs, it is desirable to utilize existing sparse-matrix techniques. We describe a quadratic programming method based on the classical Schur complement. Its key feature is that much of the linear algebraic work associated with an entire sequence of iterations involves a fixed sparse factorization. Updates are performed at every iteration to the factorization of a smaller matrix, which may be treated as dense or sparse. The use of a fixed sparse factorization allows an "off-the-shelf" sparse equation solver to be used repeatedly. This feature is ideally suited to problems with structure that can be exploited by a specialized factorization. Moreover, improvements in efficiency derived from exploiting new parallel and vector computer architectures are immediately applicable. An obvious application of the method is in sequential quadratic programming methods for nonlinearly constrained optimization, which require solution of a sequence of closely related quadratic programming subproblems. We discuss some ways in which the known relationship between successive problems can be exploited. 40 refs., 1 tab.

7101 **(UCID—21234) The Conflict Model (ConMod) interim technical overview.** Chiu, Yu-Hsing, Burback, R.L.; Jones, C.D.; Pancotti, R.L.; Simonson, S.C.; Strange, S.M.; Toms, R.M. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002248/JAW.

The Conflict Model (ConMod) is an automated, high-resolution, echelons-above-corps (EAC) conflict simulation, which is in development at the Conflict Simulation Center (CSC) of Lawrence Livermore National Laboratory (LLNL). The project is jointly sponsored by the Army and LLNL, with Air Force participation in the form of two officers assigned to the project team. This paper is intended to provide prospective users of (ConMod) with an understanding of its basic characteristics. By "prospective users" three groups are included: those who will work with ConMod directly; those who will interact with the model, such as in operational support or training modes; and those who will use the results of studies made with ConMod. The project origins are discussed, together with development plans, and potential applications. The requirements expressed by the Army and the Laboratory are summarized. Next, the design concepts of ConMod will be described. These will be elaborated in two major areas, software design and simulation design. In the software area, first the software development methods used by the project will be discussed. Then the system support environment will be described. In the simulation area, first the model architecture will be described. Then the major new modeling area, command and control (C^2) simulation will be discussed, including the automated aspects of C^2 and its application at the operational level. Input and output data requirements are then discussed, and an estimate of the required computer resources concludes the paper. 17 refs.

7102 **(UCRL—15957) Software enhancements and modifications to Program FDTD executable on the Cray X-MP computer.** Stringer, J.C. (Stringer (James C.), Austin, TX (USA)). 4 Sep 1987. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001877/JAW.

This report summarizes enhancements and modifications to PROGRAM FDTD executable on the Cray X-MP computer system. Specifically, the tasks defined and performed under this effort are revision of the material encoding/decoding scheme to allow material type specification on an individual cell basis; modification of the I/O buffering scheme to maximize the use of available central memory and minimize the number of physical I/O accesses; user interface enhancements. Provide enhanced input/output features for greater flexibility; increased modularity. Divide the code into additional modules for ease of maintenance and future enhancements; and assist in the conversion and testing of FDTD to Float-

ing Point Systems scientific computers and associated peripheral devices.

7103 **(UCRL—15968) Monte Carlo photon transport on vector and parallel superconductors: Final report.** Martin, W.R.; Nowak, P.F. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 30 Sep 1987. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002454/JAW.

The vectorized Monte Carlo photon transport code VPHOT has been developed for the Cray-1, Cray-XMP, and Cray-2 computers. The effort in the current project was devoted to multitasking the VPHOT code and implement it on the Cray X-MP and Cray-2 parallel-vector supercomputers, examining the robustness of the vectorized algorithm for changes in the physics of the test problems, and evaluating the efficiency of alternative algorithms such as the "stack-driven" algorithm of Bobrowicz for possible incorporation into VPHOT. These tasks are discussed in this paper. 4 refs.

7104 **(UCRL—97517) Recent developments in the numerical solution of differential/algebraic systems.** Petzold, L.R. (Lawrence Livermore National Lab., CA (USA)). 9 Oct 1987. Contract W-7405-ENG-48. 20p. (CONF-871230—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001885/JAW.

From 8. international conference on computing methods in applied mechanics; Versailles, France (14 Dec 1987).

In this paper we survey some recent development in the numerical solution of nonlinear differential/algebraic equation (DAE) systems of the form O = F/t,y,y'), where ∂F/∂y' may be singular. Initial value problems in DAEs arise in a wide variety of applications, including circuit and control theory, chemical kinetics, modeling of constrained mechanical systems, fluid dynamics and robotics. DAE systems include standard form ODEs as a special case, but they also include problems which are in many ways quite different from ODEs. We explore some classes of initial value problems which can be solved by backward differentiation formulas, and discuss some results on the order of convergence of implicit Runge-Kutta methods applied to DAE systems. Finding a consistent set of initial conditions is often a problem for DAE systems arising in applications. We outline some recent work on a general algorithm for finding consistent initial conditions. Finally, we discuss some new developments in the numerical solution of DAE boundary value problems. 29 refs.

7105 **(UCRL—97552) The workstation/mainframe connection.** Requa, J. (Lawrence Livermore National Lab., CA (USA)). 6 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-8709183—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002387/JAW.

From Cray user group meeting; Bologna, Italy (22 Sep 1987).

This paper describes the work going on at LLNL to develop a graphic oriented workstation interface to a network operating system. The paper describes one interface, designed to meet existing user requirements and one prototype network interface with two implementations, intended to explore a part of the available interface design space.

7106 **(UCRL—97570) Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems.** Gregg, H.; Healey, K.; Hack, E.; Wong, C. (Lawrence Livermore National Lab., CA (USA); National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center; Lockheed Engineering and Management Services Co., Inc., Houston, TX (USA); National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Oct 1987. Contract W-7405-ENG-48. 9p. (CONF-871182—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002386/JAW.

From 3. conference on artificial intelligence for space applications; Huntsville, AL, USA (2 Nov 1987).

Traditional expert systems, such as diagnostic and training systems, interact with users only through a keyboard and screen, and are usually symbolic in nature. Expert systems that require access to data bases, complex simulations and real-time instrumentation have both symbolic as well as algorithmic computing needs. These needs could both be met using a general purpose workstation running both symbolic and algorithmic code, or separate, specialized computers networked together. The latter approach was chosen to implement TEXSYS, the thermal expert system, developed by NASA Ames Research Center in conjunction with Johnson Space Center to demonstrate the ability of an expert system to autonomously control the thermal control system of the space station. TEXSYS has been implemented on a Symbolics workstation, and will be linked to a microVAX computer that will control a thermal test bed. This paper will explore the integration options, and present several possible solutions. 8 refs., 3 figs.

7107 **Piecewise homogeneous random walk with a moving boundary.** Percus, O.E.; Percus, J.K. (Courant Institute of Mathematical Sciences, New York Univ., New York, NY 10012). *SIAM Journal on Applied Mathemadics;* 47: No. 4, 822-830(Aug 1987).

The authors study a random walk with nearest neighbor transitions on a one-dimensional lattice. The walk starts at the origin, as does a dividing line which moves with constant speed, γ, but the outward transition probabilities rho/sub A/ and rho/sub B/ differ on the right- and left-hand sides of the dividing line. This problem is solved formally by taking advantage of the analytical properties in the complex plane of an added variable generating function, and it is found that rho/sub A/, rho/sub B/ space decomposes into four regions of distinct qualitative properties. The asymptotic probability of the walk being to the right of the moving boundary is obtained explicitly in three of the four regions. However, analysis in the fourth region is a sensitive function of the denominator of the rational fraction γ, and so they conclude with a number of special cases which can be solved in closed form.

7108 **Zero models and pole models for multivariable systems.** Zhang, S.Y. (Brookhaven National Lab., Upton, NY). pp 778-781 of Proceedings of the 1986 American control conference. Piscataway, NJ; IEEE Service Center (1986). (CONF-860638—Vol.1).

From American control conference; Seattle, WA, USA (18 Jun 1986).

In this paper, the author introduces the concepts of zero models and pole models for the multivariable systems. The definitions are different from the existing definitions of pole and zeros for multivariable systems, they reflect more structural informations for the systems, and can be used to study the external properties of the systems. The pole models and zero models in the closed-loops are also discussed. It is shown that the zero models of the closed loop systems play a key role in the tracking and rejection problem.

7109 **Comparison of time domain and frequency domain state feedbacks.** Zhang, S.Y. (Brookhaven National Lab., Upton, NY). pp 788-789 of Proceedings of the 1986 American control conference. Piscataway, NJ; IEEE Service Center (1986). (CONF-860638—Vol.1).

From American control conference; Seattle, WA, USA (18 Jun 1986).

In this paper, the author presents the equivalence of the time domain and frequency domain state feedbacks as well as the dynamic state feedback and a modified frequency domain state feedback, from the closed-loop transfer function point of view. The difference of the two approaches are also shown.

7110 **A modified post processing correction matrix for SPECT.** Macey, D.J.; De Nardo, G.L.; De Nardo, S.J.; Seibert, J.A. (Div. of Nuclear Medicine, Dept. of Radiology, UCDMC, 4301 X Street, FOLB II-E, Sacramento, CA 95817). pp 189-192 of International workshop on physics and engineering of computerized multidimensional imaging and processing. Nalcioglu, O.; Cho, Z.H.; Budinger, T.F. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8604213—).

From International workshop on physics and engineering of computerized multidimensional imaging and processing; Newport Beach, CA, USA (2 Apr 1986).

A post reconstruction method of attenuation compensation for Single Photon Emission Computed Tomography (SPECT) has been investigated that offers a new approach to the problem of quantitation. A modified correction matrix is generated for attenuation compensation in which the Linear Attenuation Coefficient (LAC) for each pixel is assigned a value depending on the radial distance of the pixel from the true section boundary. Attenuation compensation of transverse section images of small and large volume sources of Tc-99m in phantoms using this modified matrix indicated that a known quantity of radionuclide could be determined to better than 10%. The scatter fraction was estimated as the difference in the corrected section images using a multiplicative matrix generated with a constant LAC for each pixel and the modified matrix proposed in this paper.

7111 **Crystal identification in modular array detectors for high spatial resolution PET.** Weinberg, I.N.; Dahlbom, M.; Ricci, A.; Hoffman, E.J. (Div. of Nuclear Medicine and Biophysics, Dept. of Radiological Sciences, The Lab. of Nuclear Medicine and UCLA School of Medicine, Los Angeles, CA 90024). pp 261-268 of International workshop on physics and engineering of computerized multidimensional imaging and processing. Nalcioglu, O.; Cho, Z.H.; Budinger, T.F. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8604213—).

From International workshop on physics and engineering of computerized multidimensional imaging and processing; Newport Beach, CA, USA (2 Apr 1986).

The use of detector arrays in PET has been proposed and studied as a economical means of obtaining very high resolution images. The properties of detector arrays for use in high resolution PET scanners were investigated. Analytical approximations and Monte Carlo simulations were used to design detector arrays consisting of six to eight crystals coupled to two photomultipliers to allow identification of the individual crystals. Arrays of 2.85 mm thick crystals of Bismuth Germanate (BGO), Gadolinium Orthosilicate (GSO), and Barium Fluoride (BaF/sub 2/) were examined. The effect of interdetector materials such as lead, and plastic on positioning accuracy was tested. Assembled arrays of six 2.85 mm thick BGO crystals yielded line spread function FWHMs of 2.4 to 3.2 millimeters. The limiting resolution of detector arrays was found to be defined by the scintillation light yield of the crystals, the light gathering efficiency of the detector arrays, and the fraction of interdetector scatter.

7112 **On the applicability of the Maximum Likelihood Estimator algorithm for image recovery in accelerated positron emitter beam injection.** Llacer, J.; Andreae, S.; Chatterjee, A. (Lawrence Berkeley Lab., Univ. of California, Mailstop 29-100, Berkeley, CA 94720). pp 269-276 of International workshop on physics and engineering of computerized multidimensional imaging and processing. Nalcioglu, O.; Cho, Z.H.; Budinger, T.F. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8604213—). Contract AC03-76SF00098.

From International workshop on physics and engineering of computerized multidimensional imaging and processing; Newport Beach, CA, USA (2 Apr 1986).

The Maximum Likelihood Estimator (MLE) algorithm for tomographic image reconstruction is being investigated in substantial detail by a number of research groups, as it appears to promise images with very low noise and increased sharpness when compared with filtered backprojection techniques. Recently, however, it has been found that the reconstruction of data from uniform activity distributions exhibits strong peaks and valleys when the number of iterations increases toward a maximum in the likelihood function. This problem has now been investigated with the authors Positron Emitter Beam Analyzer (PEBA) camera, which, because of its small size and favorable geometry, has allowed an analysis with enough detail to find the origin of that apparent instability. The findings can be summarized as follows: 1) The very low noise of the MLE reconstructions comes about by the ability of the Poisson-based MLE algorithm to generate an image which favors the matching of experimental data (detector pairs) containing few counts. 2) The image instability at a high number of iterations is a direct consequence of the above characteristic. 3) The matrix of probability elements needed for the MLE reconstruction provides the link between the two above observed phenomena. It appears that, by proper system design, it is possible to obtain the favorable low noise characteristic without the instability. The applicability of the above findings to true tomography (PEBA does not carry out a true tomographic reconstruction) seems direct, but confirmation should be obtained by further research on the question.

7113 **Plasma simulation and fusion calculation.** Buzbee, B.L. (Computing Div., Los Alamos National Lab., Los Alamos, NM). pp 417-424 of High speed computation. Kowalik, J.S. New York, NY; Springer-Verlag New York Inc. (1984). (CONF-830685—).

From NATO Advanced Research Institute workshop on high speed computation; Juelich, F.R. Germany (20 Jun 1983).

Particle-in-cell (PIC) models are widely used in fusion studies associated with energy research. They are also used in certain fluid dynamical studies. Parallel computation is relevant to them because PIC models are not amenable to a lot of vectorization - about 50% of the total computation can be vectorized in the average model; the volume of data processed by PIC models typically necessitates use of secondary storage with an attendant requirement for high-speed I/O; and PIC models exist today whose implementation requires a computer 10 to 100 times faster than the Cray-1. This paper discusses parallel formulation of PIC models for master/slave architectures and ring architectures. Because interprocessor communication can be a decisive factor in the overall efficiency of a parallel system, the author shows how to divide these models into large granules that can be executed in parallel with relatively little need for communication. The author also reports measurements of speedup obtained from experiments on the UNIVAC 1100/84 and the Denelcor HEP.

7114 **A parallel first-order method for parabolic partial differential equations.** Rodrigue, G. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 329-342 of High speed computation. Kowalik, J.S. New York, NY; Springer-Verlag New York Inc. (1984). (CONF-830685—). Contract W-7405-ENG-48.

From NATO Advanced Research Institute workshop on high speed computation; Juelich, F.R. Germany (20 Jun 1983).

In this paper, it is shown how computing architectures have affected the direction of research in deriving numerical time - differencing schemes for parabolic partial differential equations. In particular, the problem of solving the two-dimensional diffusion equation is considered.

7115 **Parallel processing of sparse structures.** Kuck, D.J.; Gajski, D.D. (Dept. of Computer Science, Univ. of Illinois at Urbana-Champaign, 1304 West Springfield, Urbana, IL 61801-2987). pp 229-246 of High speed computation. Kowalik, J.S. New York, NY; Springer-Verlag New York Inc. (1984). (CONF-830685—).

From NATO Advanced Research Institute workshop on high speed computation; Juelich, F.R. Germany (20 Jun 1983).

In earlier works, the authors presented a relationship between data structures, program structures, and machine structures. Under the assumption that an algorithm or program has been put in parallel form, this relationship holds across a wide range of programming languages and computer architectures. Thus the data, program, and machine structures presented are basic concepts that have many possible implementations. In that paper, the data structures considered were scalar data, array or string data that is accessible with "regular indexing," and "other data" including sparse or "irregularly indexed" arrays, trees, graphs, etc. In this paper, the authors consider these other data structures in more detail. The goal of this paper, together with their previous works and possibly further extensions to other data structures, is not just to provide a taxonomy, but rather to provide an absolute checklist for a given system's functionality, to provide a means for comparing the overall capabilities of various systems and, to provide a basis for deciding what kind of system is required for a particular application as reflected in its programs or algorithms.

7116 **The S-1 Mark IIA supercomputer.** Farmwald, P.M. (Lawrence Livermore National Lab., Livermore, CA). pp 145-158 of High speed computation. Kowalik, J.S. New York, NY; Springer-Verlag New York Inc. (1984). (CONF-830685—). Contract W-7405-ENG-48.

From NATO Advanced Research Institute workshop on high speed computation; Juelich, F.R. Germany (20 Jun 1983).

This paper describes The S-1 Mark IIA Multiprocessor System. It is composed of up to 16 supercomputer class uniprocessors with multiple local caches, an extremely large, medium-latency high-bandwidth shared memory, and a low-latency synchronization mechanism for passing short messages. The system is applicable to a wide variety of applications, including large-scale physical simulation, real-time command and control and program development in a time-sharing environment. The hardware organization, its implications, and software supporting the efficient utilization of the multiprocessor are discussed.

9903 Information Handling

REFER ALSO TO CITATION(S) 6504, 7055, 7058, 7073, 7074, 7082, 7091, 7093

7117 **(CONF-871128—1) The magic is off: Doing more with less.** Loebl, A.S. (Oak Ridge National Lab., TN (USA)). 2 Nov 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001737/JAW.

From NARDAC Washington/ORNL/DSRD conference on expert systems technology in the ADP environment; Washington, DC, USA (2 Nov 1987).

This paper deals with the use of data processing techniques in normal Naval business practices and strategies. In particular the use of productivity tools and expert systems are discussed. 1 fig.

7118 **(GKSS—87/E/1) GKSS scientific-technical reports of the year 1986.** (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1987. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750550/JAW.

The survey lists authors and titles of all external reports published in 1986 by the GKSS (E-reports). Following the list, all publications are characterised by an abstract and/or bibliographic data, except for reprints of journal articles.

7119 **(INDC(CCP)—274/L) Translation of selected papers published in Nuclear Constants 5(59), 1984.** (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jun 1987. 115p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

The papers selected for this issue of the publication deal with the following topics: The Neutron Physics Constants Bank of the I.V. Kurchatov Institute of Atomic Energy - its structure and contents such as libraries, programs and data preparation codes for reactor calculations. A new version of the unified constant system package (called OKS) has been developed for access to constant systems, such as ARAMAKO-2F, in calculating radiation transport. Input language and performance are described. The group neutron data library GNDL is described in terms of structure, organization and basic data representation formats. The ARMAN'YAK code is described. Its calculation time, special features, and present state are briefly mentioned. Use of the code (for the preparation of constants for calculations and for compiling a library of files of nuclear concentrations) is indicated. A library of neutron data for calculating group constants - the FOND library - is described. The computerized library includes data on the 67 most important nuclear reactor and radiation shielding materials. Under the title "The INDEhkS program and machine system" a set of programs for the comparative analysis of calculated and experimental data from integral and macroscopic experiments is presented. The present status of the ARAMAKO multigroup constant calculation system for solving neutron and gamma quantum transport equations is reviewed. A method and a program for automatic preparation of few-group constants for reactor calculations in three-dimensional hexagonal geometry is proposed. A program (GRUKON) for calculating group constants on the basis of libraries of evaluated neutron data is presented. Evaluation of the methodical error in 26-group approximation is discussed. The accuracy of calculation of linear and bilinear functionals using a 26-group approximation is evaluated. A description is given of a five-group system of constants along with a status report on its development.

7120 **(INDC(SEC)—093/UN) INDC list of correspondents for the exchange of nuclear data information and compilation of national nuclear data committees.** (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Sep 1987. 135p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700654/JAW.

This list supersedes INDC(SEC)-91/UN.

This list of INDC Correspondents, including information on currently existing National Nuclear Data Committees and their memberships, is compiled and published upon the request of the International Nuclear Data Committee with the objective to promote the interaction and enhance the awareness of nuclear data activities in IAEA Member States. It also serves as a basis for the distribution of documents originated by or for the International Nuclear Data Committee and includes the names of all recipients of INDC documents. The INDC Secretariat tries to maintain this list up-to-date in order to facilitate an efficient interchange of information on nuclear data topics. The report is presented in five sections. The first section contains a detailed description of the INDC distribution categories, distribution codes and document designator codes. The second section describes the aims, organization and objectives of individual national nuclear data committees. The third section lists names and addresses in alphabetical order within each state or international organization together with the assigned INDC document distribution code(s); where applicable committee membership and/or area of specialization are indicated. This is followed by four shorter lists, indicating the names of individuals in each distribution category, sorted by country or international organization, and the total number of individuals in each category. The final section provides the names of nuclear data committee members also listed by country or international organization.

7121 **(INDC(SEC)—094/UN) List of documents received by the INDC Secretariat.** (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Sep 1987. vp. NTIS (US Sales Only), PC Axx/MF A01. Order Number DE88700655/JAW.

This list supersedes INDC(SEC)-92/UN.

The Nuclear Data Section of the International Atomic Energy Agency receives documents originated by or for the International Nuclear Data Committee for distribution. This list includes all INDC documents received and distributed by the INDC Secretariat during the period January 1984 to March 1986. This list is produced directly from computer printout in two sorts: one ordered by accession number, and the other ordered by document number within each origin series (e.g. listing all INDC(SEC)-documents in one block). In addition to the INDC documents received by the INDC Secretariat for distribution, this document also lists the titles of reports received as single copies for information.

7122 **(INIS-mf—10748) List of HMI reports. As of June, 1987.** (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bibliothek). 1987. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751022/JAW.

The Hahn-Meitner-Institute Berlin publishes a series of reports with the results of R+D work of the institute. This list of publications contains also an author index in alphabetical order which points to annual reports of the institute as well as to the reports of the sections of nuclear and radiation physics, nuclear chemistry and reactor, and the section data processing and electronics. With 440 refs..

7123 **(K/CSD/INF—87-23) Bar code document accountability system performance update.** Wade, D.J.; Mountain, P.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1987. Contract AC05-84OT21400. 37p. (CONF-871132—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002256/JAW.

From Micrographic and information management conference; Boulder, CO, USA (3 Nov 1987).

This paper contains an up-to-date summary of the Bar Code Document Accountability System (BARDAS). BARDAS was developed to demonstrate the feasibility of improving the management and reporting timeliness of secret document inventories by the accountable custodians at the Department of Energy's Oak Ridge and Paducah plants. This paper discusses enhancements to the BARDAS and the use of bar code technology in accomplishing these enhancements.

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